PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

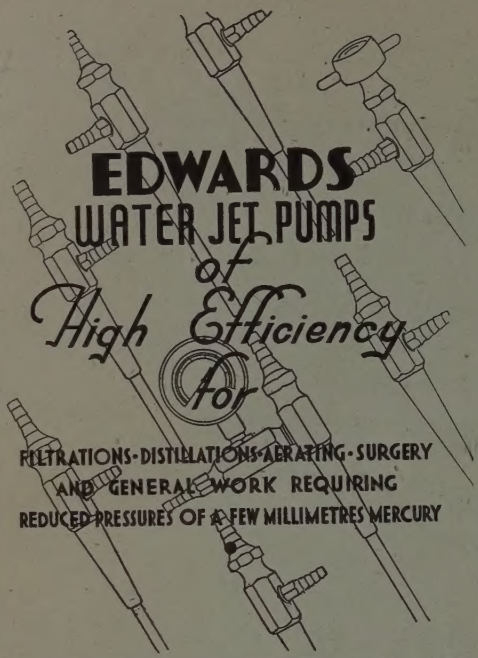
THE PHYSICAL SOCIETY

THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 1459-1755

VOLUME 49 **JUNE 1946** NUMBER 582



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NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers. (An abridged version of the U.D.C. accompanies the Annual Index.) An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

Abstracts signed with the following initials have been supplied by the courtesy of the organizations named: "E. R. A." = British Electrical and Allied Industries Research Association. "M. A." = Metallurgical Abstracts. "M.-V." = Metropolitan-Vickers Electrical Co., Ltd. "P. O." = Post Office Engineering Research Department.

MATHEMATICS 51

512.52 1459

Formulae for direct and inverse interpolation of a complex function tabulated along equidistant circular arcs. SALZER, H. E. *J. Math. Phys.*, **24**, 141–3 (*Nov.*, 1945).—Formulae are given for quadratic, cubic and quartic interpolation. Inverse interpolation is briefly considered. L. S. G.

512.831 : 621.392.52 : 621.318.7 1460

Applications of matrix algebra to filter theory. RICHARDS, P. I. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 145–50*P* (*March*, 1946).—[Abstr. 1354 B (1946)].

514.6 : 527 : 518.5 *see Abstr.* 1470

517.392 : 536.2 1461

On certain integrals in the theory of heat conduction. HORENSTEIN, W. *Quart. Appl. Math.*, **3**, 183–4 (*July*, 1945).—The integrals

$$\int_0^t x^{-n} \exp(-a^2/x - b^2x)dx$$

where $n = \frac{1}{2}$ and $\frac{3}{2}$, are expressed in terms of tabulated functions, one of which is the error function. L. S. G.

517.433 : 621.3.011 1462

The steady-state operational calculus. WAIDELICH, D. L. *Proc. Inst. Radio Engrs, N.Y.*, **34**, 78–83*P* (*Feb.*, 1946).—The direct and inverse transforms of the steady-state operational calculus are presented, together with two methods of evaluating the inverse transform, the first resulting in a Fourier series and the second giving a sum function. A proof of the inversion theorem connecting the two transforms is outlined. Two examples are presented illustrating the application of this operational calculus to circuit problems, and a comparison is made between the ordinary and the steady-state operational calculi.

517.51 1463

Theorems concerning functions subharmonic in a strip. HARDY, G. H., AND ROGOSINSKI, W. W. *Proc. Roy. Soc. A*, **185**, 1–14 (*Jan.* 10, 1946).—A subharmonic function is defined, and the principal theorem is that if $f(x, y)$ is subharmonic and bounded above in the half-strip, $\alpha < x < \beta$, $y > \gamma$, then either (1) $\overline{\phi}(x) = \overline{\lim_{y\to\infty}} f(x, y) = -\infty$ for $\alpha < x < \beta$, or (2) $\overline{\phi}(x)$ is continuous and convex for $\alpha < x < \beta$. It is also shown that the integral of $f(x, y)$ over all values of y is a continuous convex function of x. Various applications are made. One relates to integrals taken along a line on which x is constant; another to the theory of conformal representation. L. S. G.

517.522.2 = 4 1464

Formulae for the coefficients of inverse power series. KAMBER, F. *Acta Math., Uppsala*, **78** (*Pts I–II*) 193–204 (1946) *In French.*—Given the power series $x^m = y^m(1 + mT)$, where

$$T = c_1y + c_2y^2 + \ldots$$

the problem is to revert the series to give $y^n = x^n(1 + nS_n)$, where

$$S_n = b_{n,1}\,x + b_{n,2}\,x^2 + \ldots$$

Here m and n need not be integral. The formula of Lagrange is used to find the coefficients b_{ni} ($i = 1, 2, 3, \ldots$) and it is shown that each b_{ni} may be written as a determinant, e.g. $b_{n1} = -c_1$ and

$$b_{n2} = \frac{1}{2!\,(2+n)}\begin{vmatrix}(2+n)c_1 & 2(2+n)c_2\\ 1 & (2+n+m)c_1\end{vmatrix}$$

As an example the series $\xi = \gamma_1\eta + \gamma_2\eta^2 + \ldots$ is reverted to give $\eta = \beta_1\xi - \beta_2\xi^2 + \ldots$, the β_i being determinants involving the γ_j. In another example the derivative $\mathfrak{d}^n = d^nx/dy^n$ is expressed in terms of the derivatives of y with respect to x, thus $\mathfrak{d}^1 = (y')^{-1}$, $\mathfrak{d}^2 = -y''(y')^{-3}$,

$$\mathfrak{d}^3 = (y')^{-5}\begin{vmatrix}3y''/2 & y'''\\ y' & 2y''\end{vmatrix}, \ldots$$

L. S. G.

517.564 1465

On some integrals involving Bessel functions. BOSE, B. N. *Bull. Calc. Math. Soc.*, **37**, 77–80 (*Sept.*, 1945).—The Laplace transforms of certain expressions involving Bessel functions, e.g. $p^{\frac{1}{2}}I_0(ap^{\frac{1}{2}})$, $I_{2n+1}(ap^{\frac{1}{2}})$, $p^{\frac{1}{2}}I_{2n}(p^{\frac{1}{2}})$, are found and used to evaluate some integrals in closed form. Among these are

$$\int_0^\infty \frac{e^{-y}I_n(y)y^n}{(a+y)^{n+\frac{1}{2}}}dy \qquad (a > 0),$$

$$\int_0^{\frac{1}{2}\pi} \exp(-a^2\sin^2\theta)\,I_0(a^2\sin^2\theta)\sin\theta\,d\theta$$

and $$\int_0^{\frac{1}{2}\pi} I_n(a\sin^2\theta)\exp(-a\sin^2\theta)(\sin\theta)^{-1}\,d\theta$$

L. S. G.

517.564 1466

Table of Bessel functions J_n(1 000). CORRINGTON, M. S. *J. Math. Phys.*, **24**, 144–7 (*Nov.*, 1945).—The table covers the range $n = 935(1)1\,035$. Entries are given to eight decimal places. The table was computed for use in the spectrum analysis of a frequency-modulated radio wave. L. S. G.

518.12 1467

A convergent iterative process. SAMUELSON, P. A. *J. Math. Phys.*, **24**, 131–4 (*Nov.*, 1945).—An equation $x = g(x)$ is often solved by an iteration of the form $x_{n+1} = g(x_n)$. When the convergence is slow it may be made more rapid by using $y_{n+1} = h(y_n)$ where

$$h(y) = \frac{[g\{g(y)\}]^2 - g(y)g[g\{g(y)\}]}{2g\{g(y)\} - g(y) - g[g\{g(y)\}]}$$

This process is generalized in three different directions. L. S. G.

518.3 : 536.2 : 532.542.4 1468

Logographs. TOUR, R. S. *Trans. Amer. Soc. Mech. Engrs*, **68**, 143–9 (*Feb.*, 1946).—A new type of chart is presented for graphical solution of equations of the form $T^pU^qV^rW^s = K$, depending basically on the addition of logarithms. They develop from the fact that a straight line drawn on semilog paper represents a function of the form: $\log y = \alpha + bx$, or $x = c + n \log y$. Their construction is explained and exemplified in the development of a chart for the calculation of heat-transfer coefficients in turbulent flow. Charts are also given for the turbulent flow of fluids in pipes and for the flow of fluids through sharp-edged orifices. The equations underlying the last two charts represent new forms of the standard expressions and are briefly discussed and their limitations indicated.

518.5 1469

A computer for solving linear simultaneous equations. BERRY, C. E., WILCOX, D. E., ROCK, S. M., AND WASHBURN, H. W. *J. Appl. Phys.*, **17**, 262–72 (*April*, 1946).—The mathematical principles of the classical iterative method of solving linear simultaneous equations are discussed. Basic electrical circuits for setting up an analogue of the mathematical relations are given comprising potentiometer networks for multiplying and adding voltages, and a commercial model of a 12-equation computer is briefly described. The results of solving a number of problems on the computer are given to illustrate its accuracy and speed of operation. It is found that solving sets of 12 equations requires only $\frac{1}{4}$ to $\frac{1}{7}$ the time required by conventional methods.

518.5 : 527 : 514.6 1470

A new instrument for solving spherical triangles. MATTHEWS, B. H. C. *Proc. Roy. Soc. A*, **185**, 241–9 (*March* 14, 1946).—The instrument was designed for use in celestial navigation by amateur yachtsmen. It is much more rapid to use than the tables usually employed, and can be made to be accurate to $\pm\frac{1}{2}'$ of arc in calculating zenith distance. A Wheatstone bridge arrangement is used to effect the computations. Twin potentiometers, each having two moving contacts, are set by dials marked in angle to make resistances represent the appropriate derivations of latitude, declination, hour angle and zenith distance. When one of these is unknown, if the potentiometers are balanced the fourth resistance gives the solution. The instrument may be used to solve any spherical triangle for a body above the observer's horizon for declinations and latitudes up to about 80°. L. S. G.

518.5 : 53 1471

Simple differential equations arising in physics; rapid solution by using hatchet planimeters. CALLENDER, A. *J. Sci. Instrum.*, **23**, 77–81 (*April*, 1946).—The principle of the hatchet planimeter is explained and the theory is given of the methods in which this planimeter is used to solve approximately practical physical problems governed by equations of the type

$$C d\theta/dt = k(\phi - \theta)$$

$$C_2 d\theta_2/dt = k_2(\theta_1 - \theta_2)$$

or $$C_1 d\theta_1/dt + C_2 d\theta_2/dt = k_1(\phi - \theta_1)$$

Such equations arise in a large number of analogous problems, e.g. thermodynamic, electrical, hydraulic, mechanical, etc. Two examples, taken from the theory of heat flow, are given. L. S. G.

518.5 : 535.317.1 = 4 *see Abstr.* 1566

518.5 : 621–531 1472

An apparatus for investigating the behaviour of regulating devices. VON FREUDENREICH, J. *Brown Boveri Rev.*, **31**, 228–32 (*July*, 1944).—[Abstr. 1246 B (1946)].

518.5 : 621.389 1473

The ENIAC, an electronic calculating machine. HARTREE, D. R. *Nature, Lond.*, **157**, 527 (*April* 20, 1946).—The machine is designed for the step-by-step integration of equations, and operates by the counting of electrical pulses produced at 100 000 per sec. These are fed to the scale-of-10 counting circuits by electronic switches according to the operation (addition, multiplication, etc.) to be carried out. There are 3 function tables, on which may be set up sets of values required for the calculation, and the machine will interpolate between values according to the interpolation formula supplied to it. The addition units provide a "memory" of capacity about 20 numbers, which are immediately available for further calculations. The final results are delivered on punched cards. The whole machine comprises 18 000 valves, 3 000 lamps and 5 000 switches, and takes about 150 kW in operation.

518.61 1474

Table of coefficients for double quadrature without differences, for integrating second order differential equations. SALZER, H. E. *J. Math. Phys.*, **24**, 135–40 (*Nov.*, 1945).—The table is chiefly of use in the numerical integration of equations of the form $y'' + g(x)y = 0$ or $y'' + \phi(x, y) = 0$. The method for the latter is illustrated. The table may be used to calculate a function whenever its second derivative is known at equally spaced points. It was constructed by applying a double quadrature to the well-known Lagrangian interpolation formula. Cases are covered where the second derivative is approximated by polynomials ranging from the second to the tenth degree. L. S. G.

519.24 1475

Information and accuracy attainable in the estimation of statistical parameters. RAO, C. R. *Bull. Calcutta Math. Soc.*, **37**, 81–91 (*Sept.*, 1945).—Certain inequality relations are derived connecting the elements of the information matrix, as defined by Fisher, and the variances and covariances of the estimating functions. A class of distribution functions which admit estimation of parameters with the minimum variance is discussed. The concept of distance between populations of a given type is developed, starting from a quadratic differential form defining an element of length. L. S. G.

519.283 : 621.791.7 : 621.311.153 = 397 1476

Overlapping of welding loads. HERLITZ, I. *Tekn. Tidskr.*, **76**, 226 (*March* 2, 1946) *In Swedish.*—[Abstr. 1271 B (1946)].

519.4 : 548.1 = 4 *see Abstr.* 1727

522.21 1477

Important considerations in making reflecting telescopes. VAUGHN, F. *J. R. Astr. Soc. Can.*, **39**, 53–8 (*Feb.*, 1945).—Details reasons why some reflectors fail to perform well due to ignoring many practical points. The amateur produces high quality main mirrors, time costing nothing, which would be very expensive if made by a professional. The use of flats of only a fair degree of flatness is deplored, yet a certain large sale popular book condones this practice. Poor support systems for main mirrors are a frequent cause of lack of definition. The best materials and the design of the tube for a reflector are discussed.

E. G. M.

523.11 : 531.51 : 530.12 *see Abstr.* 1491

523.37 1478

The infra-red spectrum of the moon. ADEL, A. *Astrophys. J.*, **103**, 19–24 (*Jan.*, 1946).—Gives preliminary results using a potassium bromide prism spectrometer on an image of the full moon of diameter $\frac{3}{4}$ in, passed over a slit. The possibility of using the radiations from the earth and moon to study the night atmosphere is demonstrated. The only prior work on the lunar spectrum was by Langley in 1889.

E. G. M.

523.7 1479

Solar physics. HUNTER, A. *Rep. Phys. Soc. Progr. Phys.*, **9**, 101–12 (1942–43).—The previous review by A. D. Thackeray (1940) is brought up to date. The coronal spectrum, and in particular the work of Edlén [Abstr. 344 (1943)], is discussed, and the bright chromospheric eruptions and their geophysical effects are reviewed. Other topics treated are the motion of solar prominences and convection in the sun. The relevant literature is listed.

L. S. G.

523.746 : 537.591.5 *see Abstr.* 1667

523.841.1 : 523.87 *see Abstr.* 1486

523.841.9 1480

Spectrographic observations of the eclipsing variables W Ursae Minoris, XZ Sagittarii and KO Aquilae. SAHADE, J. *Astrophys. J.*, **102**, 470–9 (*Nov.*, 1945).—Three eclipsing binaries of short period with marked differences in the depths of the two minima. Results from 29, 27 and 39 spectrograms respectively:

W U. Min.: Primary, A3; period, 1·70116 days; $\gamma = -17{\cdot}9$ km/sec; $K = 86{\cdot}6$ km/sec; $e = 0{\cdot}09$; $\omega = 221°{\cdot}6$; $T =$ phase $0{\cdot}611d$; $a \sin i = 2{\cdot}0 \times 10^6$ km; $f(m) = 0{\cdot}11\odot$.

XZ Sgr.: Primary A3; secondary F or G; $K \sim 11$ km/sec; period $3{\cdot}3d$. The mass function is very small and possibly implies a very high ratio for the masses of the two components.

KO Aql.: Primary A0 or A1; $P = 2{\cdot}863844$ days; $\gamma = -2{\cdot}7$ km/sec; $K = 37{\cdot}8$ km/sec; $e = 0{\cdot}02$; $\omega = 130°{\cdot}9$; $T =$ phase $0{\cdot}372$ days; $a \sin i = 1{\cdot}5 \times 10^6$ km; $f(m) = 0{\cdot}016\odot$.

D. S. E.

523.841.9 : 523.87 1481

Spectrographic observations of the eclipsing variable TT Hydrae. SAHADE, J., AND CESCO, C. U. *Astrophys. J.*, **103**, 71–5 (*Jan.*, 1946).—During and near total eclipse double emission lines of hydrogen appear and undergo eclipses. The probable origin is a gaseous ring, similar to that suggested by Struve for SX Cassiopeiae.

D. L. E.

523.841.9 : 523.87 1482

Spectrographic observations of eleven eclipsing binaries. STRUVE, O. *Astrophys. J.*, **103**, 76–98 (*Jan.*, 1946).—Velocities and orbital elements are given for all the stars observed. Two of them (VW Cyg., AQ Peg.) show H emission lines, during principal minimum, which undergo eclipses. Data for these and 6 other eclipsing binaries with gaseous rings are included in a detailed discussion of such systems. These may be common, but conditions necessary for observation greatly restrict the number detected.

D. L. E.

523.87 1483

Preliminary report on a spectrophotometric investigation in Kapteyn's selected areas. Nos. 2, 6, 7, 15, 16 and 19. ELVIUS, T. *Stockholms Obs. Ann.*, **14** (*No.* 8) 1–18 (1945).—The paper gives results for six selected areas. Photographs with the 40 cm Zeiss astrograph at the Stockholm Observatory covering one square degree, give short spectra down to 13·5 m with an exposure of two hours. Special plates have been taken at another focus to reach the H and K lines, to classify the A-type stars. [See Abstr. 1898 (1934)]. Monochromatic magnitudes are derived and corrected to form photographic magnitudes on the International System. For both early and late type stars the criteria used to classify the spectral types are given, and comparisons with Harvard, Bergedorf and Mount Wilson are made. The correlation coefficients for 86 stars common to Bergedorf, Mount Wilson and this paper are between +0·85 and +0·93. A comparison of the separation of giants and dwarfs by Bergedorf and the author shows less agreement, the correlation coefficient being +0·33. The relation between colour index and spectral type is examined.

E. G. M.

523.87 1484

Interstellar lines in the spectrum of β Lyrae. MERRILL, P. W. *Publ. Astr. Soc. Pacif.*, **57**, 306–7 (*Dec.*, 1945).—Tabulated displacements of Ca II and Na I lines give a weighted mean of −18·2 km/sec. As the velocity of the centre of mass is −19·0 km/sec the lines may be circumstellar, though an interstellar origin is not excluded. Additional faint D lines show velocities corresponding to the expanding B5 shell.

D. L. E.

523.87 1485

The spectrum of BD + 67° 922. WILSON, R. E. *Publ. Astr. Soc. Pacif.*, **57**, 309–10 (*Dec.*, 1945).—Tables are given of emission and absorption line displacements in 7 spectra taken in 1943–45. There is no evidence of variability and the star appears to be a single dwarf ($M = +5{\cdot}0$) but with a combination spectrum in which the absorption and emission lines have different displacements. A difference (7 km/sec) between the mean displacements of H and He I may also be significant.

D. L. E.

523.87 : 523.841.1 1486

The spectrum of Nova Aquilae 1945. SANFORD, R. F. *Publ. Astr. Soc. Pacif.*, **57**, 312–14 (*Dec.*,

1945).—Photographs taken between Aug. 31 and Oct. 24, 1945, are reproduced. Two sets of absorption components displaced to the violet of emission lines showed velocities increasing from −1 980 to −2 610 and −1 150 to −1 350 km/sec respectively. The latter split up on Sept. 12 into two components, one of about −1 200 and the other increasing from −1 460 to −1 630 km/sec. Emission lines of H, He II, N II and [O III] are noted in the photographic region, while an infra-red plate on Sept. 14 showed lines of N I, O I and the Paschen series of H. D. L. E.

523.87 : 523.841.9 *see Abstr.* 1481, 1482

523.877 : 531.19 1487

On the abundance of nuclei in the universe. LATTES, C., AND WATAGHIN, G. *Phys. Rev.*, **69**, 237 (*March* 1 *and* 15, 1946).—[See Abstr. 496 (1945), 1739 (1942)].

527 : 514.6 : 518.5 *see Abstr.* 1470

PHYSICS 53

53 : 518.5 *see Abstr.* 1471

53.08 1488

A summary statement of the principles of measurement. DALZELL, D. P. *Phil. Mag.*, **36**, 485–90 (*July*, 1945).—[See Abstr. 2374 (1944)].

53.081.6 : 530.14 *see Abstr.* 1499

53.087.25 : 621.317.351 = 3 1489

Theory of visually observable oscillograms of time-resolved periodic phenomena. HÄRTEL, W. *Z. Instrumkde*, **63**, 132–40 (*April*, 1943) *In German.*—The relations of the vertical data to time, as appearing on the screen of the oscillograph, $y = \phi(t)$, or to another variable with time as parameter, $y = \psi(x)$, are analysed, and the appearance of Lissajous figures in the second case explained. The mechanical oscillograph using a rotating mirror, and the c.r.o. using a saw tooth deflection for time resolution are considered side by side. After treating the stationary image of a phenomenon the paper deals with a slowly moving image and shows how a stroboscopic method can be applied to frequency comparisons, checks and adjustments. A. L.

FUNDAMENTALS 530.1

530.12 : 530.145.6 *see Abstr.* 1504

530.12 : 531.15 = 4 1490

The Sagnac effect in astronomy and the possibility of verifying the kinematics of relativity. PRUNIER, F. *Bull. Astr., Paris*, **12** (*No.* 7) 351–64 (1940) *In French.*—By relativity is here meant special relativity. The Sagnac effect gives the retardation of one light ray relative to another moving in an opposite direction round a rotating disc. The formula is applied to moving particles and the interval is calculated between successive coincidences of the radii to two moving planets from the centre of rotation. The theory depends on the application of results derived from the use of the Lorentz transformation, which implies that moving points are not relatively accelerated, to the case of circular motions in which the moving points necessarily have an acceleration. G. C. McV.

530.12 : 531.18 *see Abstr.* 1514

530.12 : 531.51 : 523.11 1491

A theory of regraduation in general relativity. WALKER, A. G. *Proc. R. Soc. Edinb. A*, **62** (*No.* 19) 164–74 (1946).—The regraduation of an observer's proper-time clock is discussed, starting from the local Galilean co-ordinate system at each point of a Riemannian space-time. In order to show that non-trivial regraduations exist, a new interpretation of Einstein's gravitational equations is proposed, viz. that regraduations preserve the form of the equations but alter the values of the gravitational constant and the cosmical constant. No experimental evidence is adduced for these assumptions. Particular cases are worked out in detail with special reference to Lemaitre expanding universes. It is shown that certain regraduations are possible which transform the cosmical constant to zero. G. C. McV.

530.12 : 531.51 = 4 1492

On a fundamental result in the relativity theory of gravitation. LICHNEROWICZ, A. *C.R. Acad. Sci., Paris*, **221**, 652–4 (*Nov.* 26, 1945) *In French.*—A continuation of previous work [*ibid.*, **206**, 157 and 313 (1938)] and a discussion of related work by Einstein and Pauli [Abstr. 2997 (1942) and *Ann. of Math.*, **44**, 131 (1943)]. The main result is that an external field everywhere regular, must be a field without gravitation, i.e. it must reduce to a Euclidean field. The history of various attempts to prove this is traced and some consequences of the result are listed. L. S. G.

530.12 : 531.51 : 535.1 = 4 1493

Electro-optics and universal time. DIVE, P. *Bull. Astr., Paris*, **12** (*No.* 1) 1–71 (1940) *In French.*—An attempt to develop an alternative relativistic theory of electro-optics (not based on the Lorentz transformation) following up an idea due to Poincaré, that the velocity of light signals emitted from a moving source is greater in a direction parallel to the motion of the source than in a perpendicular direction. Postulating a "universal time" t, and retaining the classical (Galilean) transformation $x = ut + x'$, $y = y'$, $z = z'$, between two systems $S(x, y, z, t)$ and $S'(x', y', z', t')$ moving relative to one another with velocity u parallel to the x-axes, and assuming that the "natural times" t and t' in S and S' are connected by the relation $t' = at + bx$, where a and b depend only on u, it is shown that light signals are propagated as spheroidal waves, of which there are two types. The physical consequences of this are discussed in detail: to the second order in u/c, c being the velocity of light, they appear to conform to those of Einstein's theory. It is claimed as an advantage that any new experimental fact involving second order effects can always be made to fit in the new theory; the same may not be the case for Einstein's theory. V. C. A. F.

530.12 : 531.51 : 538.3 1494

A generalization of special relativity theory. CORBEN, H. C. *Nature, Lond.*, **157**, 516 (*April* 20, 1946).

530.12 : 531.51 : 538.3 1495

A classical theory of electromagnetism and gravitation. I. Special theory. CORBEN, H. C. *Phys. Rev.*, **69**, 225–34 (*March* 1 *and* 15, 1946).—By extending the Maxwell–Lorentz equations to five dimensions, it is shown that one is led to a simple unified theory of

gravitational and electromagnetic phenomena. The generalized expressions for the force density and the work done per unit volume per unit time contain terms which correspond, respectively, to the effects of electric, magnetic and gravitational fields. If it be assumed that no changes of physical quantities occur in the direction of the extra dimension so introduced, a special relativity theory of gravito-electromagnetic fields arises. Within this theory gravitational waves are propagated with the velocity of light, gravitational potential is invariant for Lorentz transformations, and gravitational force acts on the rest mass of a particle. The conservation laws of charge, momentum, and energy are shown to hold, but the last two yield a generalized Poynting vector, and a generalized expression for the energy density, both of which contain terms which depend on the gravitational field strengths. The finite velocity of propagation of gravitational waves leads at once to the result that an accelerated mass emits energy in the form of such waves. On the classical theory the radiation emitted by an electron thus has associated with it a small longitudinal gravitational component. Gravitational forces are shown to lead to a self-energy for an accelerated mass, and the classical radius of a mass m, corresponding to the classical radius of a charge, is Gm/c^2, where G is the gravitational constant.

530.14 1496

The point singularity in a non-linear meson theory. WALSH, P. *Proc. R. Irish Acad.*, **50 A** (*No.* 11) 167–87 (*May*, 1945).—A meson field is considered whose equations differ from those of Maxwell in possessing: (1) Born's non-linear modification; (2) Proca's self-exciting term corresponding to a non-vanishing rest-mass of the corresponding particle. Since the meson field has a very considerable rest mass, there is an overlapping of the effects of (1) and (2) as each comes into play near the centre. The problem considered is thus more difficult than the case considered recently by Schrödinger [Abstr. 1956 (1944)] where attention was confined to the electromagnetic field. The spherically symmetric static problem is considered, and particular attention is paid to the relation between the charge and the total field energy, E. The field equation is

$$\frac{d}{dr}\left[r^{-2}\frac{d}{dr}\{r^2\psi(1-\psi^2)^{-\frac{1}{2}}\}\right] = \mu^2\psi$$

where the charge is $g = \{r^2\psi(1-\psi^2)^{-\frac{1}{2}}\}_{r=0}$ and, after obtaining a closed solution in the one-dimensional case, approximate solutions are obtained when $\eta\sqrt{g} \ll 1$ and $\mu\sqrt{g} \gg 1$. The results give some idea of the dependence of E on g. L. S. G.

530.14 1497

On the fields and equations of motion of point-particles. BHABHA, H. J., AND HARISH-CHANDRA. *Proc. Roy. Soc. A*, **185**, 250–68 (*March* 14, 1946).—This paper is concerned with point particles possessing a charge, dipole and multipole moments interacting with fields of arbitrary spin satisfying the general wave equation,

$$(\partial^2/\partial x^\mu \partial x_\mu + \chi^2)U = 0$$

The radiation field is defined as the retarded minus the advanced field and it, together with all its derivatives, is found to be always finite at all points, including those on the world line of the point particles. The symmetric field (S), defined as half the sum of the retarded and advanced fields, contains a part expressible as an integral I along the world line from $-\infty$ to $+\infty$, which is continuous and everywhere finite. If $\chi = 0$, then $I = 0$. The modified symmetric field (S^*) is defined by $S^* = S - I$. The actual field is the sum of S^* and the modified mean field, which is half the sum of the ingoing and outgoing fields plus I. It is shown that the part of the stress tensor of the field quadratic in S^* plays no part in determining the equations of motion. Being conserved by itself, it can always be subtracted away, thus defining a new stress tensor which is free from all the highest singularities in the usual stress tensor. The equations of motion depend only on the "mixed terms" in the inflow with the modified mean field substituted for the ingoing field. The formulation for several particles is given. L. S. G.

530.14 1498

On the equations of motion of point particles. HARISH-CHANDRA. *Proc. Roy. Soc. A*, **185**, 269–87 (*March* 14, 1946).—The results of the preceding paper [Abstr. 1497 (1946)] are used to obtain explicitly the equations of motion, which are independent of the particular choice of the energy-momentum tensor of the field from among the many alternatives [Abstr. 983 (1939)]. A convenient method is given for calculating the radiation field. The spin angular momentum of a point particle is defined and it is postulated that the magnitude is constant. Application of the theory is made to a charged dipole in a vector- or scalar-meson field. In the former the constancy of spin effects a great simplification in the equations of motion, which are completely determined in terms of two arbitrary constants. These are interpreted as the mass and the spin. Only those dipoles for which the "electric" and "magnetic" moments are parallel in the rest system are consistent with the assumption of constant spin. The equations in a scalar-meson field also contain two constants and these are similarly interpreted. L. S. G.

530.14 : 53.081.6 1499

A relation between some natural constants and the lesser particles. DREW, H. D. K. *Phil. Mag.*, **36**, 577–80 (*Aug.*, 1945).—The new relationship $R = m^2c/20Mh$ is deduced where R is Rydberg's general wave-number constant, m and M are the masses of the electron and neutron respectively and h is Planck's constant. Combining this with Bohr's equation $R = 2\pi^2me^4/ch^3$ we obtain

$$e = \left(\frac{ch}{2\pi}\right)^{\frac{1}{2}}\left(\frac{m}{10M}\right)^{\frac{1}{2}}$$

and this yields $h/e = 1{\cdot}375794 \times 10^{-17}$ which is nearer the observed value $1{\cdot}3765 \times 10^{-17}$ than Birge's estimate. The significance of these relations is discussed especially with reference to the possibility of the existence of a series of minute particles. L. S. G.

530.14 = 4 1500

On ten relations resulting from Dirac's second order equations. DURAND, E. *C.R. Acad. Sci., Paris*, **218**, 36–8 (*Jan.* 4, 1944) *In French.*—An outline is given of the method for deriving the relations and a physical

interpretation is given where this exists. Some of the tensors arising in the equations are related to those previously introduced by Tetrode and by Proca.

L. S. G.

530.14 = 4 1501

On the decomposition of the equations for a particle of arbitrary spin. VAN ISACKER, J. *C.R. Acad. Sci., Paris*, **219**, 51–3 (*July* 3, 1944) *In French.*—The equation of state for a particle of any spin, in the absence of an external field, is resolved into a system of equations. A sum of solutions of the latter gives a solution of the original equation. A special case is discussed in which the equation is resolved into 6 groups of equations: 1 group corresponding to particles of spin 2, 3 groups corresponding to a spin 1 and 2 groups corresponding to a spin 0. L. S. G.

530.145 : 538.3 1502

Quantum electrodynamics with $\partial A_\mu/\partial x_\mu = 0$. CHANG, T. S. *Proc. Roy. Soc. A*, **185**, 192–206 (*Feb.* 12, 1946).—The results of an earlier paper [Abstr. 1243 (1945)] are summarized and the relativistic invariance of the commutation relations is proved. The Poisson brackets of A_μ (the four-potential) at two different points in space are worked out for the vacuum. A modified form of the equations of Dirac, Fock and Podolsky [*Phys. Z. Sowjet.*, **2**, 468 (1932)] is given. In this $\partial A_\mu/\partial x_\mu = 0$, but this is not true in the original theory. The modified equations also result in a quantum electrodynamics where each of the charges takes a separate time co-ordinate and $\partial A_\mu/\partial x_\mu = 0$. Finally it is shown how the equation $\partial A_\mu/\partial x_\mu = 0$ may be introduced into Dirac's new electrodynamics [Abstr. 1742 (1942)], which introduces negative energy states for photons during the second quantization, and how, as a result, the longitudinal part of the field can be eliminated. L. S. G.

530.145 : 538.3 : 537.122 *see Abstr.* 1625

530.145.6 1503

Note on the theory of vector wave fields. BROER, L. J. F., AND PAIS, A. *Proc. Ned. Akad. Wet.*, **48**, 190–7 (1945).—It is shown that Fermi's method of treating the electromagnetic field can be applied to the classical but not to the quantum theory of the vector meson field. The role of the Lorentz condition in this connection is examined. V. C. A. F.

530.145.6 : 530.12 1504

The conformal Dirac equation. HAANTJES, J. *Proc. Ned. Akad. Wet.*, **44** (*No.* 3) 324–32 (1941).—A conformal wave equation is one which is invariant under a conformal transformation of the fundamental tensor: $g_{ik} \rightarrow \sigma^2 g_{ik}$. It is shown that the Dirac equations for particles without mass are conformal, but the equation for mass particles is conformal only if we assume that the mass m becomes transformed thus: $m \rightarrow m/\sigma$. Under this assumption the physical dimension $[ML]$ is invariant. The physical interpretation of invariance under conformal transformation in special relativity is discussed. Conformal invariance of physical laws means the equivalence of observers which have a constant acceleration with respect to each other. L. S. G.

530.145.6 : 537.122 1505

Relativistic interaction of electrons on Podolsky's generalized electrodynamics. MONTGOMERY, D. J. *Phys. Rev.*, **69**, 117–24 (*Feb.* 1 *and* 15, 1946).—The wave equation for a system of particles is derived on the basis of Podolsky's generalized electrodynamics [Abstr. 1906 (1945), 206 (1943)]. An extension of some work of Fock [Abstr. 602 (1935)] leads to a representation in terms of a series of functionals. With this formalism the matrix element for the relativistic interaction of two electrons is determined and is seen to be a generalization of Møller's formula [Abstr. 3719 (1931)].

530.145.6 : 537.133 *see Abstr.* 1632

530.145.6 = 4 150(

On the wave mechanics of elementary particles. KWAL, B. *C.R. Acad. Sci., Paris*, **218**, 548–50 (*March* 27, 1944) *In French.*—Two important properties of the outer multiplication of matrices are stated and used to deduce the primary equations describing particles of spin $\frac{1}{2}$, 1 and $\frac{3}{2}$. For the particle of spin j there are 2^{2j-1} systems of primary equations, each consisting of $2j$ groups of 2^{2j} equations (ψ, the wave function, has 2^{2j} components). The secondary equations for a particle of spin $\frac{1}{2}$ are discussed. These involve the use of spinors. L. S. G.

530.145.6 = 4 1507

The principle of correspondence for an asymptotic classical mechanics. STUECKELBERG, E. C. G. *C.R. Soc. Phys. Hist. Nat., Genève*, **61**, 155–8 (*April–July* 1944) *In French.*—The equation of motion in Dirac's theory of the electron [Abstr. 3660 (1938)] is discussed and it is noted that, because of the possibility of non-physical solutions, final as well as initial conditions must be imposed. This leads to a discussion of the equation describing the variation of physical quantities and to the introduction of a "rational" and an "asymptotic" mechanics. In these the final state is represented, in different ways, in terms of the initial values. The correspondence between the two types of mechanics is explained.

L. S. G.

530.145.6 = 4 1508

The principle of correspondence for an asymptotic quantum mechanics. STUECKELBERG, E. C. G. *C.R. Soc. Phys. Hist. Nat., Genève*, **61**, 159–61 (*April–July* 1944) *In French.*—Certain recent work of Dirac [Abstr. 3660 (1938)] is criticized and the methods of Heisenberg [Abstr. 2109 (1944)] are considered to be much better. It is shown that these are equivalent to a quantum analogue of the asymptotic classical mechanics introduced previously. A new principle of correspondence between the asymptotic quantum mechanics and the asymptotic mechanics of Schrödinger is announced. L. S. G.

530.145.6 = 4 1509

The characteristics, according to Cauchy, of the equations of particles with spin and Jacobi's relativistic equation. ARNOUS, E. *C.R. Acad. Sci., Paris*, **219**, 672–3 (*Dec.* 27, 1944) *In French.*—Wave functions in 5-dimensional space are considered. The equations for a photon, similar to the Dirac equations for an electron, are written down, and the characteristic determinant of these equations is formed. An evaluation of this leads to the Jacobi equation which occurs in the restricted theory of relativity. L. S. G.

530.145.61 1510

A calculus of finite precision—a correction. LIEBOWITZ, B. *Phys. Rev.*, **69**, 131 (*Feb.* 1 *and* 15, 1946).—[Abstr. 1238 (1945)].

530.145.65 : 536.71 1511

Average values of a group of mechanical quantities in quantum statistics of monatomic gases. DE BOER, J., AND MICHELS, A. *Physica, 's Grav.*, **7**, 369–80 (*May*, 1940).—The expansion of the partition function of a monatomic gas given by Ursell and Mayer and adapted to quantum mechanics by Uhlenbeck and Kahn [Abstr. 2512 (1938)], has been generalized to obtain a series-expansion into powers of the reciprocal volume for a group of quantities, as for instance the potential energy and the virial of the intermolecular forces of a monatomic gas. The expressions obtained are applied to calculate the deviations from the law of equipartition in quantum mechanics in the temperature region where the deviations from classical statistics are small.

530.162 : 533.723 1512

On the theory of the Brownian motion, II. WANG, M. C., AND UHLENBECK, G. E. *Rev. Mod. Phys.*, **17**, 323–42 (*April–July*, 1945).—Paper I [Abstr. 352 (1931)] gives a summary of the theory up to 1930. In the present review the general theory of random processes, and, in particular, the Gaussian random process is used as a basis for developing the theory of the Brownian motion. General random processes are described and classified and some remarks are made on the theory of discrete random series. The Gaussian random process is treated by means of the Rice method [Abstr. 1385 B (1946)] and by the diffusion-equation method due to Fokker-Planck. Then the Brownian motion of a series of coupled harmonic oscillators is studied. L. S. G.

530.162 : 621.38 1513

Mathematical analysis of random noise. I–IV. RICE, S. O. *Bell Syst. Techn. J.*, **23**, 282–332 (*July*, 1944); **24**, 47–156 (*Jan.*, 1945).—[Abstr. 1385 B (1946)].

MECHANICS OF SOLIDS 531

531.15 : 530.12 = 4 *see Abstr.* 1490

531.18 : 530.12 1514

A simple proof of the Lorentz transformation. STRAUSS, M. D. H. *Nature, Lond.*, **157**, 516 (*April* 20, 1946).

531.19 : 523.877 *see Abstr.* 1487

531.19 : 532.517.4 *see Abstr.* 1534

531.224.2 1515

The generalised buckling problem of the circular ring. BIEZENO, C. B., AND KOCH, J. J. *Proc. Ned. Akad. Wet.*, **48**, 447–68 (1945).—In the general problem the ring is subjected to radial and tangential loads, and the conditions of equilibrium of a ring-element are written down. It is shown that the general load system may be decomposed into an *A*-system, where the bending moment and the shearing force are zero, and a *B*-system where the normal force is zero. The *A*-system is studied in detail. Associated with the differential equation for the buckling is an integral equation and this is solved by an iterative method. Numerical results are given for various analytical types of compressive forces. L. S. G.

531.224.4 1516

Struts of variable flexural rigidity. DURANT, N. J. *Phil. Mag.*, **36**, 572–7 (*Aug.*, 1945).—An investigation is made of the elastic stability of a strut. The equation of flexure is

$$d^2y/dx^2 + k_1 e^{kx/l}(y - \delta) = 0$$

where k, k_1, l and δ are constants. It is integrated in terms of Bessel functions for all values of k. It is integrable in terms of elementary functions when $k = 0$. The condition for stability is determined and a table of values of the critical thrust is given for various values of k. The case $k \to 0$ is investigated, since this is the familiar case of a uniform strut.

L. S. G.

531.23 1517

An application of the method of finite difference equations to a problem of bending moments.—Continuous beam of *N* equal spans under transverse loading and an axial force. DURANT, N. J. *Phil. Mag.*, **36**, 569–72 (*Aug.*, 1945).—The problem of a previous paper [Abstr. 1250 (1945)] is generalized so that the effects of clamping the ends of the beam and applying an axial force may be considered. This is a case where the principle of superposition cannot be used. A formula is derived for the bending moment at any support and some particular cases are considered.

L. S. G.

531.23.08 = 69 1518

The moment indicator and its application to models of 2-dimensional structures. HENRIQUES DOS REIS, E. A. *Técnica* (*April*, 1944). *Publ. Centro Estud. Engenharia Civ.* (*No.* 2) 17 *pp.* (1944) *In Portuguese.*—The table for mounting the indicator is described and illustrated and the theory of the apparatus is developed [see *Proc. Amer. Soc. Civ. Engrs*, **64**, 8, 1613–25 (Oct., 1938)]. The application to celluloid models of various structures is explained, including determination of bending moments in rigid frames. J. A. W.

531.259 1519

On plastic bodies with rotational symmetry. SEDGEWICK, C. H. W. *Quart. Appl. Math.*, **3**, 178–82 (*July*, 1945).—A calculation is made of the lines of principal stress and the lines of maximum shearing stress in some special cases. Networks of cycloids or logarithmic spirals, known in the case of plane strain, are also admissible in the case of rotational symmetry. L. S. G.

531.259.1 : 532.51 1520

Equations for elastic solids in spherical co-ordinates. VENING MEINESZ, F. A. *Proc. Ned. Akad. Wet.*, **48**, 469–86 (1945).—Working in a general orthogonal co-ordinate system differential equations are set up which are satisfied by the displacements in an elastic solid. Similar equations are given for the velocity in a viscous fluid. The equations are solved under certain functional restrictions on the components of the mass forces and elastic displacements, etc. Particular attention is paid to a spherical co-ordinate scheme; over the area studied, the temperature is variable but gravity is assumed to be constant and in a radial direction. Various properties of the solutions are noted. L. S. G.

531.33 : 534.014.5 = 4 1521

On the theory of synchronization. HAAG, J. *C.R. Acad. Sci., Paris*, **221**, 682–4 (*Dec.* 3, 1945) *In French.*—A perturbed harmonic oscillator is considered, which is governed by an equation of the type

$$\theta'' + \omega^2\theta = \lambda k(t, \theta, \theta')$$

where λ is a positive constant and k is a function periodic in t and of period T. Conditions are established under which, for sufficiently small λ, a unique periodic solution, of period T, exists. One of these conditions is that $\frac{1}{2}\omega T/\pi$ be non-integral. A method of successive approximation is used in studying the equation. L. S. G.

531.382/.384 1522

Bowling greens and bowls. COLE, J. H., AND BALLS, W. L. *Nature, Lond.*, **157**, 380–1 (*March* 23, 1946).—The peculiar behaviour of bowls on a green with a pronounced "nap" is described, and an explanation attempted.

531.391.1 : 621.855 1523

Energy losses in the chain-belt problem. ARCHIBALD, F. R. *Mech. Engng, N.Y.*, **68**, 139–42 (*Feb.*, 1946).—[Abstr. 1480 B (1946)].

531.51 : 523.11 : 530.12 *see Abstr.* 1491

531.51 : 530.12 = 4 *see Abstr.* 1492

531.51 : 535.1 : 530.12 = 4 *see Abstr.* 1493

531.51 : 538.3 : 530.12 *see Abstr.* 1494, 1495

MECHANICAL MEASUREMENTS 531.7

531.711 : 531.751.1 : 536.5.081.3 : 537.081.3 1524

Units and standards of measurement. EVANS, J. C. *Nature, Lond.*, **157**, 538–40 (*April* 27, 1946).—A report of a discussion on recent advances in evaluating the standards of length, mass, temperature and the theoretical units of electricity.

531.714.2 : 535.243 : 537.533.73 1525

The precision of measurement of broad spectrum lines, with special reference to electron-diffraction photographs. RYMER, T. B., AND BUTLER, C. C. *Phil. Mag.*, **36**, 515–33 (*Aug.*, 1945).—A statistical study of an extensive set of data yields the following working rule: the standard deviation of a single reading of the position of a line by means of a measuring microscope may be taken as $0{\cdot}3d^{\frac{1}{2}}$, where d is the line width, if all lengths are measured in microns; and about half this in the case of a microphotometer reading. The systematic errors and methods for their determination are discussed. The validity of the estimates of systematic and random errors is confirmed by a comparison with theory of the radii of electron-diffraction circles. L. S. G.

531.717.1 : 541.182.2 1526

A method of determining the size of droplets dispersed in a gas. STOKER, R. L. *J. Appl. Phys.*, **17**, 243–5 (*April*, 1946).—The method makes use of the fact that if droplets strike a suitably coated surface without wetting the surface, a track of the contact area is formed. A criterion is derived and experimentally evaluated for relating the droplet diameter and the track diameter. An apparatus for utilizing this method is briefly described.

531.751.1 : 536.5.081.3 : 537.081.3
531.711 *see Abstr.* 1524

531.754 1527

Simple densimeter for solid objects. FORDHAM, S., AND SILLITTO, G. P. *J. Sci. Instrum.*, **23**, 83–4 (*April*, 1946).—This instrument utilizes the hydrometer principle in mercury and is useful for objects permeable to water. The solid object is held under the surface of the mercury by a weighted, graduated hydrometer rod. Stability is maintained by hanging the weight below the hydrometer on a light bent rod. The dimensions of the stem are determined from the anticipated density range of the solids and the accuracy required. With the example illustrated, densities could be rapidly read to an accuracy of 0·01 g/cm³. E. H. D.

531.788.7 : 621.316.721.076.7 1528

Ionization gauge control unit. KING, A. H. *J. Sci. Instrum.*, **23**, 85 (*April*, 1946).

MECHANICS OF LIQUIDS 532

532.123.13 : 532.595 *see Abstr.* 1535

532.13 1529

The viscosities of liquid deuterium and hydrogen. BRINKMAN, H. C. *Physica, 's Grav.*, **7**, 447–8 (*May*, 1940).—The ratio of the viscosities of liquid deuterium and hydrogen at the same temperature is approximately 2·9 [*ibid.*, 208 (1940)]. In this note it is shown that the difference may be understood if one realizes that these two substances have different molecular volumes at the same temperature.

532.133 1530

Correlation of viscosities of liquids with temperatures. TELANG, M. S. *J. Phys. Chem.*, **49**, 579–82 (*Nov.*, 1945).—From Batschinski's equation connecting mol. vols. of liquids with temperature, and Sugden's density-temperature equation, an equation is deduced: $1/\eta = [m/(1 - T_r)^{\frac{2}{3}}] - k$, where m is proportional to the zero volume, and k is a constant for a given liquid. This relation gives fairly accurate results for a wide range of liquids at all temperatures. N. M. B.

532.51 : 531.259.1 *see Abstr.* 1520

532.513 1531

Expansion in series of the exact solution for compressible flow past a circular or elliptic cylinder. MANWELL, A. R. *Phil. Mag.*, **36**, 499–510 (*July*, 1945).—The exact hodograph equations of flow and their solutions are written down and the following cases are considered: (1) expansions for a circular cylinder in isothermal or in adiabatic flow, (2) expansion for flow past an elliptic cylinder. The critical Mach numbers for the circular cylinder in isothermal and in adiabatic flow are found. L. S. G.

532.517 1532

Drainage of a vertical plate. WYLLIE, G. *Phil. Mag.*, **36**, 581–5 (*Aug.*, 1945).—A plane vertical plate is covered with a uniform film of infinite extent and thickness a and the film is allowed to descend under the action of gravity and the retardation due to its own viscosity. If x is the thickness of the film at a distance y from the top and t is the time, the profile of the film satisfies

$$-\partial x/\partial t = g\nu^{-1}x^2\partial x/\partial y$$

where g is the acceleration due to gravity and v is a constant, except at the start of the motion when another equation is satisfied. The equation to the profile is worked out, and it agrees closely with experimental results. L. S. G.

532.517 1533

A jet viscometer with variable rate of shear. MORRIS, W. J., AND SCHNURMANN, R. *Rev. Sci. Instrum.*, **17**, 17–22 (*Jan.*, 1946).—A viscometer consisting of a glass jet which is inserted in a closed system is described. With this instrument high rates of shear of the order of magnitude of 100 000 sec^{-1} can be reached for hydraulic oils. Observations on straight mineral oils of sufficiently high viscosity to exclude turbulence, on refined rape oil and on castor oil, showed that Poiseuille's law was obeyed, i.e. the rate of flow was strictly proportional to the pressure difference applied to the jet. On the other hand, for colloidal solutions temporary viscosity reductions became apparent when $1/t$, the reciprocal value of the time of flow of a given volume, was plotted against p, the pressure difference. For colloidal solutions the results suggest an analytical criterion for assessing the transition from laminar to turbulent flow at high rates of shear. In the laminar region, $\log(pt)$ was found to decrease linearly with increasing values of the log of the mean rate of shear. With the instrument described here, laminar flow was found to persist when Reynolds' numbers up to about 44 000 were encountered. However, the critical Reynolds' number is not necessarily the same for the same oil and two different jets, as the beginning of turbulence may depend upon the geometrical shape of the jet.

532.517.4 : 531.19 1534

On the application of statistical mechanics to the theory of turbulent fluid motion. A hypothesis which can serve as a basis for a statistical treatment of some mathematical model systems. II. BURGERS, J. M. *Proc. Ned. Akad. Wet.*, **43** (*No.* 9) 1153–9 (1940).—In continuation of Part I [see Abstr. 704 (1946)] the author discusses in a tentative manner: (1) the form of the dissipation equation chosen as the basis for the statistical calculations, and (2) whether the introduction of a point lattice into the phase space, as in Part I, improves previous investigations of turbulence. J. S. G. T.

532.542.4 : 536.2 : 518.3 *see Abstr.* 1468

532.595 : 532.123.13 1535

The behaviour of liquids in shear. RICHARDSON, E. G. *Phil. Mag.*, **36**, 490–9 (*July*, 1945).—A liquid with coefficients of elasticity and viscosity is subjected to shearing forces of a simple harmonic nature. A method is given for deducing the values of the two coefficients by plotting the distribution of amplitude of oscillation throughout the system. Two cases are considered: (1) the liquid in the form of a column extending along the y axis is given an oscillatory torque $\theta = \theta_0 e^{ipt}$ over the face $y = 0$; (2) the sides of the column are given an oscillatory torque—the same throughout the column—and the waves are propagated radially. In the experiments described it is the modulus of the linear displacement amplitude at each radial distance which is actually measured. A hot-wire anemometer is used for this purpose. Results are given for oil and for sols of cellulose acetate and gelatine of small concentration. L. S. G.

532.613.4 1536

Time factor and minima in tension curves. MATTHEWS, J. B. *Nature, Lond.*, **157**, 407–8 (*March* 30, 1946).

532.62 1537

Soap bubbles in reverse. ROSE, L. *Nature, Lond.*, **157**, 299 (*March* 9, 1946).—By dropping H_2SO_4 Na_2SO_4 solution containing surface-active material into water, bubbles can be formed consisting of thin spherical shells of air, with acid Na_2SO_4 inside and water outside.

532.64 1538

Anomalous behaviour of fused cryolite. SCOTT, T. R. *Nature, Lond.*, **157**, 480–1 (*April* 13, 1946).—The addition of a minute amount of Pb, Bi or Tl to cryolite fused in a Pt crucible instantaneously stops the "wetting" of the Pt surface by the melt, which forms a single drop with sharply defined boundaries. The similar, but not so marked behaviour of other compounds is also described.

532.7 : 535.371 *see Abstr.* 1590

532.71 : 536.7 1539

Thermo-osmosis at ordinary temperatures and its analogy with the thermomechanical effect in He II. DERJAGUIN, B., AND SIDORENKOV, G. *C.R. Acad. Sci., URSS*, **32** (*No.* 9) 622–6 (1941).—Abnormal properties of He II have been explained by the fact that thin films bordering a solid boundary have an enthalpy which differs from that of the body of the liquid. Films of several liquids have been studied at ordinary temperatures by observing the flow produced through a porous glass filter by a temperature gradient across the filter. Coating the walls of the pores with oleic acid halved the velocity of flow through the filter. An expression is derived thermodynamically for the total flow through such a filter in terms of a constant which is independent of the apparatus and the geometry of the pores. Estimates of the differences in heat capacity between the film and the bulk liquids are made for water, 0·1N NaCl soln., methyl and isoamyl alcohols, acetic acid and carbon tetrachloride. E. H. D.

532.712 1540

Osmotic pressure of rod-shaped particles in solution. POLSON, A. *Nature, Lond.*, **157**, 406–7 (*March* 30, 1946).—An expression is obtained for the dependence of osmotic pressure on concentration, in terms of the ratio of the diffusion constant to that at infinite dilution.

MECHANICS OF GASES 533

533.15 1541

The determination of the coefficient of diffusion of mercury vapour and cadmium vapour in nitrogen. SPIER, J. L. *Physica, 's Grav.*, **7**, 381–4 (*May*, 1940).—N_2 streams in a tube under a pressure of 2 mm Hg and at room temperature. The metal vapour diffuses against this stream and is excited by means of a condensed discharge. The emitted radiation varies in intensity along the tube and is measured photographically. From these measurements the coefficient of diffusion (reduced to N.T.P.)

of Hg vapour was found to be 0·14 cm²/sec and of Cd vapour 0·17 cm²/sec.

533.16 1542

The viscosity of hydrogen vapour. KEESOM, W. H., AND KEESOM, P. H. *Comm. K. Onnes Lab., Leiden* (*No.* 257*c*). *Physica, 's Grav.*, **7**, 29 (1940).—New measurements of the viscosity of the saturated vapour of liquid hydrogen from 14–20·5°K are reported. The viscosity can be represented by the formula $\eta = (0{\cdot}584T - 0{\cdot}55) \times 10^{-6}$ poise.

533.5 1543

Simple automatic control for vacuum systems. SPADARO, J. J., VIX, H. L. E., AND GASTROCK, E. A. *Industr. Engng Chem.* (*Analyt. Edit.*), **18**, 214 (*March*, 1946).

533.6.07 1544

Supersonic wind tunnel laboratory. BARNES, G. M. *Mech. Engng, N.Y.*, **67**, 827–33, 835 (*Dec.*, 1945). *Mech. World*, **119**, 345–8 (*March* 29, 1946).—Two supersonic tunnels have been constructed in the U.S. Army Ordnance Department's Ballistic Research Laboratory in Maryland, one ballistic and the other for bombs. The latter has separate nozzles for each Mach number used, but the ballistic tunnel, not yet complete, has an elaborate variable nozzle. Owing to waves being reflected back on to the model, the range Ma. 0·9–1·1 cannot be used in wind tunnel tests. Spinning models are being developed. A "schlieren" or "streak" camera is used to record the effects. In the bomb tunnel the measuring apparatus is of the 3-component type; that of the ballistic tunnel will measure 6—lift, drag, and overturning moment of the model, the side force and the 2 components of the moment of the side force. The bomb tunnel, in use since 1944, has immensely speeded up bomb design, for it cuts out all the lengthy and uncertain field trials of new types. The paper is well illustrated.

W. A. R.

533.6.07 : 621.631.01 1545

A study of surging in fan or compressor systems. BINDER, R. C. *J. Franklin Inst.*, **241**, 125–36 (*Feb.*, 1946).—[Abstr. 1474 B (1946)].

533.723 : 530.162 *see Abstr.* 1512

533.73 : 541.122.4 1546

Some considerations of Dalton's law for gaseous mixtures. FOÁ, A. *Chem. and Ind.*, 97–9 (*March* 2, 1946).—Dalton's law of partial pressures is held not to provide a satisfactory interpretation of the physical conditions resulting in a gaseous mixture, in which the kinetic energy and spatial distribution of the various molecules tend to become uniform, but to imply that the molecules of the different gases are incapable of responding to any but homologous molecules. Dalton's interpretation also neglects the actual space taken up for each component by the molecules and their effective spheres of action, and the alternative view of Leduc and Amagat is shown to be more satisfactory when it is recognized that the fundamental interdependent quantities in a liquid-vapour system are temperature and vapour concentration in the gas phase. The probability concept introduced into the diffusion process is shown likewise to invalidate Dalton's interpretation. Entropy considerations are next dealt with. For mixtures of gases, the additive property belongs to the volumes and not the pressures.

H. H. HO.

ACOUSTICS . VIBRATIONS 534

534.014.5 : 531.33 = 4 *see Abstr.* 1521

534.133 : 537.228.1 *see Abstr.* 1636

534.222.2 : 537.523.4 *see Abstr.* 1648

534.31 1547

The mechanical action of instruments of the violin family. SAUNDERS, F. A. *J. Acoust. Soc. Amer.*, **17**, 169–86 (*Jan.*, 1946).—[See Abstr. 830 (1940), 276 (1938)]. There is no physical quality observed in old violins (seven "Strads") which cannot be found in new ones. The "characteristic tone" of old Italian violins does not depend on (*a*) the quality of their steady tones, (*b*) the mechanical ease with which the steady tones are produced, (*c*) the distribution of strength with frequency, (*d*) the length of the duration of the tone after the excitation is cut off. The author hesitates to say that there is no real difference in the tones of old and new instruments, for the reason that a very few especially gifted and experienced listeners can distinguish an old violin of high quality, even over the radio. It is suspected that there are minute differences which are either too small to measure, or which have been masked by the large variations found in the comparison experiments. The paper discusses the chemical and physical changes in wood and varnish due to ageing, and atmospheric conditions; the comparative weights of old and new violins (seven Strads averaged in weight 385 grams, whilst thirteen new violins averaged 410 grams). Research is needed on the effects of age and of continued vibration on wood, using strips (not violins) with which the properties Young's modulus, density, velocity of sound, damping coefficient, etc., can conveniently be measured.

A. B. W.

534.321.9 : 620.179.16 1548

The supersonic reflectoscope, an instrument for inspecting the interior of solid parts by means of sound waves. FIRESTONE, F. A. *J. Acoust. Soc. Amer.*, **17**, 287–99 (*Jan.*, 1946).—[Abstr. 1236 B (1946)].

534.321.9 : 669.18 : 620.191.33 1549

The detection of cracks in steel by means of supersonic waves. DESCH, C. H., SPROULE, D. O., AND DAWSON, W. J. *J. Iron Steel Inst.*, 23 *pp.* (*Advance copy, March*, 1946).—[Abstr. 1240 B (1946)].

534.372 1550

A new anti-vibration support. WEIL, R. *Nature, Lond.*, **157**, 481 (*April* 13, 1946).

534.62 1551

The application of the Helmholtz resonator to the measurement of sound absorption. TUCKER, W. S. *Phil. Mag.*, **36**, 473–85 (*July*, 1945).—Let K_1 be the damping coefficient, due to radiation and viscous losses concerned with the neck of the resonator, and let K_2 be the amount by which this is increased by the absorption in the interior walls of the resonator. The experimental method described for measuring sound absorption derives the value of K_1 from a resonator with perfectly reflecting walls and the values of $K_1 + K_2$ from one with porous walls. It is shown that the absorbing power is $\alpha = K_1/(K_1 + K_2)$.

Values of α are found from resonance curves for 6 frequencies ranging from 150 to 600 c/s, the material being porous earthenware. L. S. G.

534.845 1552

Sound-absorption characteristics of Indian materials. II. CHATTERJEE, S., AND DUTT, N. *Indian J. Phys.*, **19**, 35–46 (*April*, 1945).—[See Abstr. 1747 (1945)]. This paper presents a theoretical investigation of the sound-absorption characteristics of rigid porous materials based on the treatment given by Lord Rayleigh. The nature of variation of sound-absorption coefficient with angles of incidence as well as frequencies of sound wave incident on rigid porous surfaces of various characteristics has been studied. The condition of total absorption has also been incorporated. The absorption coefficient of a sample of jute surface has been calculated theoretically from the dimensions and properties of the sample and a comparison has been made with the results obtained experimentally.

534.88 1553

Acoustic phenomena associated with the firing of a gun. HERRENDEN-HARKER, G. F. *Amer. J. Phys.*, **13**, 351–62 (*Dec.*, 1945).—Existing published work is extended in a theoretical treatment covering modern high-speed projectiles, with an application to sound ranging. E. H. W. B.

OPTICS . RADIATION . SPECTRA 535

535.072 : 537.531 *see Abstr.* 1650

535.1 : 531.51 : 530.12 = 4 *see Abstr.* 1493

535.215 : 621.383.42 1554

A new electrolytic selenium photocell. VON HIPPEL, A., SCHULMAN, J. H., AND RITTNER, E. S. *J. Appl. Phys.*, **17**, 215–24 (*April*, 1946).—[Abstr. 1386 B (1946)].

535.23.08 = 4 1555

Symmetrical thermopiles. BAYLE, A. *Commun. Lab. Inst. Opt. Paris*, **1**, 36–51 (*July*, 1944) *In French.*—Discusses properties of thermopiles for measurement of radiant energy; if all the junctions are identical (i.e. either set may be selected as the hot junction) it is possible to compensate the effect of stray radiation. Full constructional details are given, including a means of blackening the surface. N. C.

535.234 1556

Planck's radiation formula derived without atomicity. DINGLE, H., KENDALL, D. G. *Nature, Lond.*, **157**, 515 (*April* 20); 556 (*April* 27); 737 (*June* 1, 1946).

535.24 : 535.8 = 4 1557

Stray light in instrument photometry. ARNULF, A. *Commun. Lab. Inst. Opt., Paris*, **1**, 3–17 (*July*, 1944) *In French.*—Stray light leads to errors in measurements of transmission factors, as well as reducing the contrast of the image. The apparent transmission factor (ratio between image brightness and object brightness) is the sum of the (constant) transmission factor of the instrument itself and the stray light factor, which varies with the conditions of illumination of the field. The stray light is measured experimentally by finding the brightness of the image of a perfectly black object. Experimental details are given of an apparatus designed by Fabry; stress is laid on the elimination of the Stiles–Crawford effect by a suitable design of instrument. N. C.

535.241.42 = 4 1558

General method of representation of candle-power distribution. DOURGNON, J. *Rev. Gén. Élect.*, **53**, 119–23 (*June*, 1944) *In French.*—Describes a simple photoelectric apparatus for measuring the luminous intensity distribution from a source. Various projection networks for representing the distribution are considered, with particular reference to the study of street lighting. If an equal-area projection is required, the author recommends Lambert's projection with the axis horizontal, the lines of longitude being equally spaced horizontals and the lines of latitude (angles of azimuth) verticals whose spacing is proportional to the cosine of the co-latitude. J. W. T. W.

535.241.42 : 621.325.17 = 4 1559

Luminous intensity of arc lamp projectors. GODFERT. *Bull. Soc. Franç. Élect.*, **4**, 125–30 (*May*, 1944) *In French.*—[Abstr. 1356 B (1946)].

535.241.431 : 628.9 1560

New methods for point by point calculations. GOODBAR, I. *Illum. Engng, N.Y.*, **41**, 39–76 (*Jan.*, 1946).—[Abstr. 1481 B (1946)].

535.243 : 537.533.73 : 531.714.2 *see Abstr.* 1525

535.243 = 4 1561

Spectrophotometry of sources having a line or band spectrum with continuous background. GOUFFÉ, A., AND WAGUET, P. *Rev. Gén. Élect.*, **53**, 33–6 (*Feb.*, 1946) *In French.*—Discusses the special problem of spectrophotometric measurements when the spectra consist of lines or bands superposed on a continuous background. The effect of the slit width is considered. In the case of a band, the measurement is made with the exit slit wider than the entrance slit by an amount equal to the width of the band. The special difficulties due to closely spaced lines in the spectrum are discussed. J. W. T. W.

535.243–32 : 535.247.4–32 1562

A photoelectric spectrophotometer for the Schumann region. LITTLE, E. P. *J. Opt. Soc. Amer.*, **36**, 168–71 (*March*, 1946).—A photoelectric spectrophotometer for measuring reflectances and transmittances of polished specimens at various angles of incidence has been developed for use in the Schumann region. Such measurements of reflectances at two or more angles of incidence permit the calculation of the index of absorption and the index of refraction of materials opaque to light of these wavelengths.

535.245.2 : 628.9.02 : 621.311.153 1563

Relation between daylight illumination and system load. SCHILLER, P. *Rep. Brit. Elect. Allied Industr. Res. Ass., Ref. K/T115*, 16 *pp.* (1945).—[Abstr. 1272 B (1946)].

535.247.4 : 620.179.6 : 535.39 *see Abstr.* 1594

535.247.4–32 : 535.243–32 *see Abstr.* 1562

535.31 = 4 1564

Graphical constructions relative to problems of elementary optics. PENCIOLELLI, G. *Commun. Lab. Inst. Opt., Paris*, **1**, 55–9 (*July*, 1944) *In French.*—An optical system sets up a homographic relationship between the object space and the image space. The characteristics of this relationship may be represented by a conic in an infinite number of ways, and it is possible to choose the representation so that the conic is a circle. It may also be possible to choose a conic

which degenerates into two straight lines or into a point. It is therefore possible to solve a large number of optical problems by graphical methods, using only simple curves. N. C.

535.316.5 : 535.33.072 *see Abstr.* 1567

535.317 1565

Monochromatic lens aberration theory. HOPKINS, H. H. *Phil. Mag.*, **36**, 546–68 (*Aug.*, 1945).—An attempt is made to develop a theory of lens aberrations on a basis of differences in optical path, expressed in terms of the departure of the wave-front after refraction from the "paraxial" sphere. Formulae are derived for the aberrations of the wave-front of different orders. The paraxial image surface is defined and this leads to a simple physical interpretation of the curvature of the image surface. The concept of image curvature is valid for finite apertures and field angles. The Petzval surface corresponds with the "first order" paraxial image surface. Conditions for flatness of field are simply derived and a "Seidel" first-order theory of wave-front aberration is given. The possibilities of focusing-out small amounts of spherical aberration, and of coma producing a small distortion are indicated; astigmatism and distortion are discussed on a new basis. L. S. G.

535.317.1 : 518.5 = 4 1566

The principle of a mechanical integrator for studying the distribution of light in optical images. MARÉCHAL, A. *Commun. Lab. Inst. Opt., Paris*, **1**, 68–74 (*July*, 1944) *In French.*—Describes a mechanical method of carrying out the double integrals involved in the calculation of illumination distributions, allowing for the effect of spherical aberration, coma and astigmatism. A theoretical investigation of the accuracy of the method is given. N. C.

535.33.072 : 535.316.5 1567

A lens to supplant the spectrograph slit. KING, C. M. *J. Opt. Soc. Amer.*, **36**, 164–8 (*March*, 1946).—An arrangement of a cylindrical divergent lens is described, for which simplicity of manufacture, greater durability, ease of maintenance for the case of extremely narrow lines, and maximum light efficiency are claimed.

535.33.072 : 545.822 = 3 *see Abstr.* 1724

535.33.072–1 1568

"Instantaneous" presentation of infra-red spectra on a cathode ray screen. DALY, E. F., AND SUTHERLAND, G. B. B. M. *Nature, Lond.*, **157**, 547 (*April* 27, 1946).—Using as sensitive element a thermistor bolometer with a time constant of 0·01 sec, and a radiation source interrupted at 15–20 c/s, absorption spectrograms covering about 3 μ in the wavelength region 1–9 μ can be traced on a long-persistence screen in 14 seconds [see Abstr. 872 (1944)].

535.331 = 3 1569

Spectra of highly ionized sodium and magnesium. II. SÖDERQVIST, J. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 19, 33 *pp.* (1946) *In German.*—Previous work [Abstr. 1764 (1945)] is extended to cover Na IV, V and VI, and Mg VII, VI and V.

535.332 1570

Forbidden lines of bismuth Bi I. MROZOWSKI, S. *Phys. Rev.*, **69**, 169–72 (*March* 1 *and* 15, 1946).—A group of forbidden lines of bismuth Bi I, all belonging to transitions between levels of the configuration $6p^3$ was investigated and the hyperfine structures observed are collected in a table. Predicted patterns with components corresponding only to a change of the quantum number F by 0 or ± 1 and intensities calculated on the basis of usual formulae for electric dipole radiation are in best agreement with the observed ones. The absence of components corresponding to $\Delta F = \pm 2$ shows the predominantly magnetic dipole character of the radiation. All observed separations of components and wavelengths of the forbidden lines are in good agreement with the level scheme of the Bi atom previously determined by the author. [Abstr. 846 (1943)].

535.332 : 538.615 1571

The Zeeman effect in the spectrum of chlorine I. GREEN, J. B., AND LYNN, J. T. *Phys. Rev.*, **69**, 165–9 (*March* 1 *and* 15, 1946).—Zeeman effects of about 200 lines have been measured in the spectrum of Cl I and have led to the discovery of 12 new lines and about 50 new classifications. Seventeen new levels have been found. A striking example of the sharing of g-values by two configurations is demonstrated.

535.337 1572

Spectrum of high frequency discharge in air in relation to active nitrogen. TAWDE, N. R., AND MEHTA, G. K. *Phys. Rev.*, **69**, 245 (*March* 1 *and* 15, 1946).—[See Abstr. 69 (1946)].

535.338 : 538.615 1573

Some observations on the spectra of germanium. VAN DEN BOSCH, J. C., AND KLINKENBERG, P. F. A. *Proc. Ned. Akad. Wet.*, **44** (*No.* 5) 556–62 (1941).—The Zeeman effect of the stronger lines in the region 2 450–6 050 Å of Ge arc and spark spectra was investigated and compared with theory. Satisfactory agreement was found. Explosion experiments with Ge powder by the Anderson exploding wire method were carried out and some details of the observed explosion and absorption spectrograms are described.

535.338.1 : 539.153 = 4 1574

Transition probabilities in the principal series for potassium. SCHWARZ, K. H. *Physica, 's Grav.*, **7**, 361–8 (*May*, 1940) *In French.*—By means of experimental arc emission spectra determinations and a comparison with earlier results the absolute transition probabilities of the principal spectral lines of K, namely 4 047, 4 044, 3 447 and 3 446 Å were fixed at 350, 382, 62 and 71 $\times$ 10^4 sec^{-1}.

535.338.334 1575

Pressure broadening of spectral lines. JABŁONSKI, A. *Physica, 's Grav.*, **7**, 541–51 (*June*, 1940).—[See Abstr. 445 (1946)]. It is shown that the intensity distribution within a spectral line, resulting as a first approximation from the general theory of pressure broadening based on the wave mechanical Franck–Condon principle, differs by a numerical factor only from that obtained by Kuhn on the basis of the classical Franck–Condon principle. The most important simplifications made are: application of approximations for the motion of the atomic nuclei, approximate calculation of the "Condon integral" and a classical treatment of the angular momentum of the colliding atoms. Only simple collisions have been taken into consideration. Thus the applicability

of the results is limited to a certain region of frequencies of the broadened line only. If the Boltzmann factor is neglected, the temperature has no influence on the intensity distribution of the broadened line in the approximation made here. An essential difference between the collision damping theories and the wave mechanical theory is pointed out.

535.338.4 1576

On the intensity distribution among the rotational lines of AlO. COHEUR, F. P., AND COHEUR, P. M. *Phys. Rev.*, **69**, 240–1 (*March* 1 *and* 15, 1946).—The temperature indicated by the bands of spectra obtained from 9 different types of arc was ~4 000°C in each case, though the sources might have been expected to vary widely. This suggests that this temperature is merely an optimum for AlO emission, and does not necessarily represent the maximum temperature in the arc. One spectrum was obtained, however, corresponding to a temperature of ~3 000°C, in a flame, poor in oxygen, into which Al-containing nitrogen was introduced, and here the AlO intensity distribution may have indicated the true temperature of the source.

535.338.4 1577

Perturbations in the band spectrum of beryllium oxide. LAGERQVIST, A. *Nature, Lond.*, **157**, 547 (*April* 27, 1946).—[See Abstr. 2242 (1945)].

535.339 1578

A light source for the primary standard of wavelength. HSUEH, C. W. *J. Opt. Soc. Amer.*, **36**, 160–4 (*March*, 1946).—A light source for the red Cd line, 6438·4696 Å, was developed in which the important objections against the Michelson type lamp were eliminated. It consisted of a discharge tube of two Pyrex bulbs joined by a U-shaped capillary in an electric furnace maintained at a temperature between 300°C and 320°C. The current was 2·5 A. The intensity of the standard line was strong, as shown by the short exposure time (30 min) required to produce an interferometer spectrogram. The effective light-emitting area was $50 \times 2{\cdot}5$ mm^2 which was large enough to cover most spectrograph slits. The Cd standard line was narrow, as shown by the interferometer spectrograms. The Doppler-effect broadening was reduced by observing the light in a direction perpendicular to that of the discharge current.

535.339.1 = 4 1579

A theoretical discussion of the transmission factor of monochromators. TERRIEN, J. *Commun. Lab. Inst. Opt., Paris*, **1**, 125–40 (*March*, 1945) *In French.*—Discusses, from the point of view of geometrical optics, the various types of monochromator in use, and investigates the effect of the dimensions and dispersions of the prisms on the performance of the instrument. Gives certain principles to be followed in designing monochromators. N. C.

535.339.1 = 4 1580

The choice of slit-widths in a double monochromator. TERRIEN, J. *Comm. Lab. Inst. Opt., Paris*, 141–8 (*March*, 1945) *In French.*—A theoretical discussion of the properties of the two main classes of double monochromator, i.e. additive and subtractive deviations. Neglecting astigmatism and aberrations it is shown that additive deviation allows double the slit-width of subtractive deviation, for the same spectral range, but this gain is at the expense of some lack of spectral purity owing to diffused radiation of other wavelengths which enter the second part of the instrument. N. C.

535.339.1 = 4 1581

Experimental investigation of a double monochromator. TERRIEN, J. *Comm. Lab. Inst. Opt., Paris*, 149–62 (*March*, 1945) *In French.*—Describes a series of tests carried out on a particular instrument, with glass prisms; the instrument was calibrated against known He and Hg lines, and curves plotted of transmitted range of wavelength against central wavelength for a constant slit-width. The effect of aberration is to reduce the final image brightness. The overall transmission was also measured. By application of the experimental method described, a full study can be made of any other monochromator. N. C.

535.343.2–15 : 549.211 1582

Infra-red absorption spectrum of diamond. KRISHNAN, R. S., AND RAMANATHAN, K. G.; SUTHERLAND, G. B. B. M. *Nature, Lond.*, **157**, 582–3 (*May* 4, 1946).—[See Abstr. 754 (1946)].

535.343.3 : 545.82 *see Abstr.* 1723

535.343.4–14 : 538.569.4 : 539.13 1583

Ammonia spectrum in the 1 cm wavelength region. BLEANEY, B., AND PENROSE, R. P. *Nature, Lond.*, **157**, 339–40 (*March* 16, 1946).—The absorption of NH_3 gas was measured over the pressure range 600–0·2 mm Hg; at high pressure by direct measurement of power absorbed in a NH_3-filled wave guide; at low pressure by measuring the damping of a NH_3-filled resonator. A spectrum of at least 20 lines was observed at low pressures. The breadth of the lines is proportional to pressure, and indicates an effective diameter for collision-broadening of the NH_3 molecule 3–5 times larger than the usual value. This is attributed to the large external field of the molecule. [See Abstr. 1576 (1934)].

535.343.4–32 1584

The absorption spectrum of acetaldehyde in the vacuum ultra-violet. WALSH, A. D. *Proc. Roy. Soc. A*, **185**, 176–82 (*Feb.* 12, 1946).—The spectrum was photographed with a normal incidence spectrograph, the grating of which was of glass, 15 000 lines to the inch, radius of curvature 1 metre. Three Rydberg series were found, all leading to the same limit, 82 505. For the first series sixteen members were observed and these enabled the ionization potential to be given as $10{\cdot}1811 \pm 0{\cdot}0007$ V. This is the most extensive Rydberg series so far found in polyatomic molcules. The exciting electron is one of the non-bonding $2p_y$ oxygen electrons. The nature of the electronic transitions responsible for the various regions of the spectrum is discussed. L. S. G.

535.343.4–32 1585

The absorption spectra of hexatriene and divinyl acetylene in the vacuum ultra-violet. PRICE, W. C., AND WALSH, A. D. *Proc. Roy. Soc. A*, **185**, 182–91 (*Feb.* 12, 1946).—The spectra were investigated in the region 2 700–1 200 Å. The spectrum of hexatriene starts with a pattern of bands in the region 2 520–2 100 Å and these are slightly degraded towards

shorter wavelengths. The stronger bands can be arranged in two progressions with differences of about 1 610 cm^{-1}. The spectrum of divinyl acetylene resembles that of hexatriene. At 2 560 Å there begins a progression of three strong diffuse bands separated by about 2 040 cm^{-1}. In both molecules the longest wavelength regions of absorption are the strongest and these are interpreted as $N \rightarrow V_1$ intravalence shell transitions. The spectra are consistent with a value of about 8·2 V for the first ionization potential of hexatriene. Calculations based on certain features of the spectra give reasonable values for the double-band resonance integral. Graphs are given which enable the first regions of absorption and the ionization potentials of the higher polyenes to be predicted.

L. S. G.

535.361.2 = 4 1586

A new method of measurement of diffuse reflection factors in the visible and the infra-red. Bayle, A. *Commun. Lab. Inst. Opt., Paris*, **1**, 52–4 (*July*, 1944) *In French.*—Describes an apparatus for measuring the diffuse reflection factor of a surface for wavelengths up to about 16 μ. By exposing the cold junction of a thermopile to the stray radiation, only the radiation actually reflected by the surface is registered. Reflection factors are found by comparing with a standard silver surface. N. C.

535.37 1587

Miscellaneous observations on the rise and decay of the luminescence of various phosphors. De Groot, W. *Physica, 's Grav.*, **7**, 432–46 (*May*, 1940).—The rise and fall in the luminescence of various crystals periodically illuminated through a rotating sectored disc by a powerful beam of u.v. light, was studied by observing the luminosity curve by means of an electron multiplier and c.r.o. The luminescence of ZnS–Ag, ZnS–Cu, ZnS . CdS–Ag, ZnS . MnS, $CaWO_4$–Sa, Zn_2SiO_4–Mn was investigated. Using earlier data on artificial willemite excited by cathode rays, the number of centres per unit vol. and the effective cross section of a centre were calculated. The effect of various experimental conditions as a function of time was studied in the case of the sulphide phosphors. Observations on ZnS . CdS single crystals illuminated by a narrow beam of monochromatic u.v. are described.

535.37 1588

Luminescence in the solid state—boric acid as base. I. Phenolic and *o*-hydroxy-carbonyl compounds as activators. Neelakantam, K., and Sitaraman, M. V. *Proc. Indian Acad. Sci. A*, **21**, 45–55 (*Jan.*, 1945).—The results for boric acid activated by sixteen *o*-hydroxy-carbonyl compounds, seven phenols, five umbelliferone derivatives, and nine other compounds are recorded and discussed. Apparently no relationship exists between the fluorescing capacity of the activator and its ability to activate phosphorescence. There is no marked distinction as activators among *o*-hydroxy-carbonyl compounds, simple phenols, and hydroxy-carbonyl compounds with two groups not in ortho positions. No parallelism is found between phosphorescence activation and intensification of fluorescence with boric acid. No definite conclusion can be drawn regarding the relationship between the type of compound formed and its effect on activation of luminescence. Umbelliferone derivatives gave the best phosphors. W. R. A.

535.37 1589

Luminescence in the solid state—boric acid as base. II. Coumarin and its derivatives as activators. Neelakantam, K., and Sitaraman, M. V. *Proc. Indian Acad. Sci. A*, **21**, 272–9 (*June*, 1945).—The results for 13 coumarin derivatives and 7 umbelliferone derivatives are recorded and discussed. Activating abilities of the coumarins are of the same order as those of the umbelliferone compounds. The intensities of phosphorescence are in some cases very strong, but the after-glow period is in no case more than 30 sec. Nearly all the compounds examined fluoresce in alcoholic solution as well as in the solid state under u.v. light. No correlation between fluorescence of activator and activating ability could be established. A free hydroxyl group is not necessary for activation and it is indicated that chemical reaction with the base is not a factor in activation. At activator concentration of 1 in 1 000 the intensity of phosphorescence reaches a maximum and remains constant at higher concentrations. The after-glow period increases with increasing concentration of activator until a maximum is reached and then shows a tendency to fall off at higher concentrations. W. R. A.

535.37 : 537.312.5 *see Abstr.* 1640

535.371 : 532.7 1590

Quenching of fluorescence by van der Waal's forces. Bowen, E. J., and Coates, E. *Nature, Lond.*, **157**, 548 (*April* 27, 1946).—The variation of fluorescence of rubrene solutions with solvent and with temperature shows two separate effects, distinguishable by their different temperature coefficients and limiting values.

535.372 : 549.211 1591

Excitation curves of luminescence in diamond. Mani, A. *Proc. Indian Acad. Sci. A*, **21**, 280–7 (*June*, 1945).—Using a monochromator, the effect of excitation by wavelengths from 3 700–6 500 Å on the fluorescence spectra of typical blue, yellow, and blue-yellow luminescent diamonds has been studied. Curves for the 4 152 and 5 032 Å systems show the existence of resonance effects for the principal electronic lines at 4 152 and 5 032 Å and, for a particular wavelength, a close correlation between intensities of fluorescence and absorption. Stokes' law is found generally to be valid but both systems are capable of being weakly excited by wavelengths greater than the principal electronic frequencies. The two systems are excited independently of each other. The colour of fluorescence is independent of wavelength except for excitation by wavelengths equal to or less than 4 152 Å for yellow fluorescent diamonds which then appear bluish-yellow. W. R. A.

535.375.55 1592

Effect of temperature on the intensities of Raman lines. Venkateswarlu, K. *Proc. Indian Acad. Sci. A*, **21**, 24–30 (*Jan.*, 1945).—The effect of temperature on the Raman spectra of liquid CCl_4 from 40–250°, and liquid benzene from 32–150° has been studied quantitatively. With increase in temperature the Stokes lines decrease in intensity, and the anti-Stokes increase, but not to the extent predicted from Placzek's theory. The ratios of the intensities of the Stokes

and anti-Stokes lines agree with the values calculated from Placzek's theory at all temperatures. In the case of CCl_4 the lines broaden out with increase in temperature, and their widths at various temperatures have been measured. W. R. A.

535.375.55 1593

Relative intensities of Raman lines in liquids. VENKATESWARLU, K. *Proc. Indian Acad. Sci. A*, **21**, 126–9 (*March*, 1945).—It is suggested that the discrepancies among the results of earlier authors are due to neglecting the effect of oblique refraction and of the different breadth characters of the various lines on their relative intensities. In this investigation the relative intensities of Raman lines in CCl_4, C_6H_6 and C_6H_5Cl are determined by comparing the aggregate intensities of the various lines and also taking into account the instrument correction. The intensity of the overtone line at about 1 550 cm^{-1} in CCl_4 is about $\frac{1}{4}$ the intensity of either of the fundamentals.

535.39 : 620.179.6 : 535.247.4 1594

A glossmeter for smoothness comparisons of machine-finished surfaces. HUNTER, R. S. *J. Opt. Soc. Amer.*, **36**, 178–81 (*March*, 1946).—[Abstr. 1237 B (1946)].

535.417 : 549.211 : 548.574 *see Abstr.* 1732

535.42 : 621.397.3 1595

A simple optical method for the synthesis and evaluation of television images. GRAHAM, R. E., AND REYNOLDS, F. W. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 18–30*W* (*Jan.*, 1946).—[Abstr. 1461 B (1946)].

535.421 1596

Energy distribution of diffraction gratings as a function of groove form. (Calculations by an equation of H. A. Rowland.) STAMM, R. F., AND WHALEN, J. J. *J. Opt. Soc. Amer.*, **36**, 2–12 (*Jan.*, 1946).—An investigation of the amount of light of a given wavelength which can be concentrated in a given order of a diffraction grating. A theoretical treatment has been given by Rowland who gave an equation for the intensity as a function of λ, groove form, etc., and this is used for the calculations presented. The results obtained are applied to gratings for Raman spectrographs, for infra-red spectrometers, and to the general case. Various types of mountings are considered and the results obtained in each case are given in both graphical and numerical form. A. H.

535.422 1597

Note on the anomalous propagation of phase in the focus. BOUWKAMP, C. J. *Physica, 's Grav.*, **7**, 485–9 (*June*, 1940).—The problem of phase anomaly in the focus of a scalar spherical wave has been frequently treated, in particular by Rubinowicz. With the help of Kirchhoff's integral, he has calculated the distribution of light due to an incident spherical wave, and its diffraction at an aperture in an infinite screen. This solution can be split up into the two cases of an incident light wave treated by geometrical optics, and a "diffracted wave" due to scattering at the diffraction edge. Kirchhoff showed that the sudden change of phase by π occurs already in the incident wave, so that the phenomenon is a geometrical optical one. The writer thinks that certain of Rubinowicz's assumptions "seem strange," and in this article describes how he himself arrives at the same conclusion in what in his opinion is a more exact way. A. E.

535.43 1598

On the theory of light-scattering.—A note. PARTHASARATHY, S. *Phil. Mag.*, **36**, 310–14 (*July*, 1945).—[See Abstr. 2119 (1940)].

535.435 : 535.51 : 541.24 1599

The depolarization of light scattered from polymer solutions. DOTY, P., AND KAUFMAN, H. S. *J. Phys. Chem.*, **49**, 583–94 (*Nov.*, 1945).—A simple apparatus, based on the Cornu method, is described. This permits the measurement of the depolarization of the transversely scattered light, using unpolarized and vertically and horizontally polarized incident light. Measurements on fractions of cellulose acetate, polyvinyl chloride, and polystyrene as a function of mol. wt., concentration and solvent are reported. The data are interpreted in terms of the changes in anisotropy and size as a function of the above variables.

535.51 : 541.24 : 535.435 *see Abstr.* 1599

535.543.2 = 4 1600

Interference phenomena between curves of vibration (continued). LE HEUX, J. W. N. *Proc. Ned. Akad. Wet.*, **44** (*No.* 8) 926–9 (1941) *In French.*—See Abstr. 1709 (1940)]. A theoretical explanation of the dark interference fringes formed by a biaxial crystalline plate when illuminated with monochromatic converging light. The shape of the fringes is deduced from the general curve

$$x = a\cos\alpha\cos\phi, \quad y = a\cos(\alpha+\theta)\cos(\phi+\Delta)$$

derived in the earlier paper. By means of a pendulum apparatus, a series of curves was drawn (16 are reproduced) and by suitable combinations of these the fringe system is calculated for ammonium magnesium phosphate and topaz. N. C.

535.642.1 1601

On the basic sensation curves of the three-color theory. DE VRIES, H. *J. Opt. Soc. Amer.*, **36**, 121–7 (*March*, 1946).—A new method is described for the measurement of the basic sensation curves of the three-colour theory of Young–Helmholtz. The sensitivity of the blue receptors for a wavelength λ is taken to be inversely proportional to the energy $E(\lambda)$ of a monochromatic field which renders a small blue spot P invisible. The colour of P is produced by a filter and remains unchanged as observations are made at different values of λ. When necessary, the discrimination of P by the green or red receptors is excluded by adding an appropriate amount of green light to the illumination of F. The absorption curve of the green and red receptors may be found when a green or a red spot P is used. Results of measurements are given and it is shown that the so-called international sensitivity curve z, which has its maximum in the blue, represents the absorption curve of the blue receptors; the international curves x and y, however, must be transformed. A tentative transformation is given. Finally it is remarked that the results are in complete variance with the so-called four-colour theory.

535.65 1602

Spectrophotometric and colorimetric determination of the colors of the TCCA (Textile Color Card Association of the United States) standard color cards. Reimann, G., Judd, D. B., and Keegan, H. J. *J. Opt. Soc. Amer.*, **36**, 128–59 (*March*, 1946).

535.7 : 535.8 = 4 *see Abstr.* 1603, 1604, 1606

535.8 : 535.24 = 4 *see Abstr.* 1557

535.8 : 535.7 = 4 1603

Image clarity in optical instruments. Influence of variations in pupil diameter and of the Stiles–Crawford effect. Arnulf, A. *Commun. Lab. Inst. Opt., Paris*, **1**, 23–35 (*July*, 1944) *In French.*—For a given individual, the clarity of the image is a function of the brightness of the observed field, as this brightness determines the pupillary diameter and the extent of operation of the Stiles–Crawford effect. Curves are given showing this relationship for various values of the diameter of the eye-piece of the instrument. As the brightness decreases, the clarity diminishes rapidly once the pupil is bigger than the eye-piece. N. C.

535.8 : 535.7 = 4 1604

Vision through an instrument with spherical aberration. I. The part played by the pupil. Françon, M. *Commun. Lab. Inst. Opt., Paris*, **1**, 163–72 (*Aug.*, 1945) *In French.*—A theoretical discussion of the effect of imperfections of the human eye. Calculations made of the effect on a perfect physical receiver bear little relationship to observations made visually, owing to the Stiles–Crawford effect and other properties peculiar to the eye. There is therefore no object in improving the performance of an instrument very much beyond that of the eye itself, and a study of the eye is a necessary preliminary to an overall investigation of the instrument. N. C.

535.8 = 4 1605

Vision through an instrument with spherical aberration. II. Visual focusing of the instrument. Françon, M. *Commun. Lab. Inst. Opt., Paris*, **1**, 173–201 (*Aug.*, 1945) *In French.*—The focusing of the instrument consists of obtaining the best compromise between the various defects of the image. The distribution of light in the image plane is calculated for instruments having various amounts of aberration and for various positions of the image plane. Experimental results are quoted, showing that the observed "best position for image plane" of a given lens was very close to the calculated value. N. C.

535.8 : 535.7 = 4 1606

Vision through an instrument with spherical aberration. III. Determination of the maximum spherical aberration permissible. Françon, F. *Commun. Lab. Inst. Opt., Paris*, **1**, 202–18 (*Aug.*, 1945) *In French.*—A theoretical investigation of the effect on the eye (assumed to be a perfect optical instrument except for the discontinuous nature of the retina). Experiments show that this assumption is justified for pupil apertures less than about 0·9 mm. For larger exit pupils, the controlling factor becomes the performance of the eye, and defects may exist in the instrument without impairing the over-all efficiency of the instrument-eye system. A formula is given connecting the position of the best image with the coefficient of third order spherical aberration, the wavelength, and the focal length of the objective. N. C.

535.81 : 681.4 = 4 1607

Production of aspherical surfaces. Dévé, C. *Rev. Opt. (Théor. Instrum.)* **23**, 39–54 (*Jan.–March*, 1944). *In French.*—Continuing earlier work on the grinding of lens and other surfaces [see Abstr. 767 (1946)] attention is now given to the kinematics of the grinding of toric and similar lenses. Rigid, semi-rigid and deformable tools are discussed and the problem of local retouching is also examined. A. H.

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536.2 1608

Approximate expression for loss of heat from exposed surfaces. Hampton, W. M. *Nature, Lond.*, **157**, 481 (*April* 13, 1946).—The heat loss H in cal/cm^2/sec from exposed surfaces by radiation and convection is given to a close approximation by $H = 10^{-4}(1{\cdot}33 + 0{\cdot}63E)\theta + 10^{-6}(0{\cdot}25 + 1{\cdot}46E)\theta^2$ where E is the emissivity (1·0 for black body) and θ is the excess of body temperature above surroundings in deg C.

536.2 : 517.392 *see Abstr.* 1461

536.2 : 532.542.4 : 518.3 *see Abstr.* 1468

536.21 1609

The accuracy of lumping in an electric circuit representing heat flow in cylindrical and spherical bodies. Paschkis, V., and Heisler, M. P. *J. Appl. Phys.*, **17**, 246–54 (*April*, 1946).—The influence of number and size of lumps is important. Several methods of lumping are conceivable and results of comparative tests show that equal geometrical size of lumps is most accurate. In the various lumps resistance and capacitance have to be in certain definite relationships, which are established in the paper. The influence of number of lumps is also investigated.

536.24 : 621-714 1610

The influence of tube shape on heat-transfer coefficients in air to air heat exchangers. Green, F. H., and King, L. S. *Trans. Amer. Soc. Mech. Engrs*, **68**, 115–22 (*Feb.*, 1946).—[Abstr. 1247 B (1946)].

536.24 : 621.133 1611

Heat transfer in the locomotive boiler. Fry, L. H. *Trans. Amer. Soc. Mech. Engrs*, **68**, 107–13 (*Feb.*, 1946).—[Abstr. 1249 B (1946)].

536.248 1612

Thermal accommodation coefficients. Wiedmann, M. L., and Trumpler, P. R. *Trans. Amer. Soc. Mech. Engrs*, **68**, 57–64 (*Jan.*, 1946).—The work of Knudsen and others is extended to cover the case of conduction through the gas layer between two infinite concentric cylindrical surfaces having different properties. Apparatus is described which enables interchangeable inner cylinders made of different materials to be used in conjunction with a single outer cylinder coated with a flat black lacquer. Measurements of the accommodation coefficients of air on the black lacquer and on polished, machined and etched surfaces of aluminium, bronze and cast iron gave values between 0·87 and 0·97. L. J. C. C.

536.4.031 : 539.13 1613

Molecular structure of deeply super-cooled water. Frank, F. C. *Nature, Lond.*, **157**, 267 (*March* 2,

1946).—The experimental observations of Rau [*Schrift Deut. Akad Luftfahrtforsch.*, **8** (*No.* 2) 65 (1944)] are described and discussed. Droplets of water on a polished Cr or Ni plate were supercooled to −72°C by repeated cooling and warming. At first freezing took place at a higher, reproducible temperature from a single nucleus, but the nucleus eventually lost its activity, and freezing then took place at a lower temperature from another nucleus. This process was repeated, −72°C being eventually reached, when the drops invariably froze, but wetted again at −70°C. The surface tension of the liquid largely disappeared below −50 or −60°C. The crystal forms at −72°C were regular octahedra or cubes, and two other modifications of ice, m.p. −40°C (hexagonal plates) and −55°C were observed. A suggested explanation is the formation of complex water molecules $H_{12}O_6$ with the O atoms at the corners of an octahedron, and with no external H bonding forces.

536.423.4 = 3 1614

Condensation of multi-component vapour mixtures. II. FISCHER, V. *Ann. Phys., Lpz.*, **42** (*Nos.* 7–8) 461–7 (1943) *In German.*—In extension of earlier work [Abstr. 2187 (1940)] it is shown how the heat of condensation withdrawn by a cooling liquid can be determined in an *iz* diagram for every section of pipe as a function of the temperature of the mixture. H. G. S.

536.48 : 536.655 *see Abstr.* 1618

536.48 : 537.312.62 *see Abstr.* 1645

536.48 : 537.312.62 : 536.631 *see Abstr.* 1616

536.5.081.3 : 537.081.3 : 531.751.1 : 531.711 *see Abstr.* 1524

536.531 1615

Heat flow effects in a resistance-type thermometer. MILLAR, N. P. *Trans. Amer. Inst. Elect. Engrs*, **64**, 678–85 (*Oct.*, 1945).—Analyses and discusses the effect of heat transfer from the surroundings on the accuracy of a resistance-type aircraft thermometer. The factors affecting the time of response of the temperature sensitive element are also considered.

R. W. P.

536.631 : 536.48 : 537.312.62 1616

The specific heats of tantalum in the normal and in the superconductive state. KEESOM, W. H., AND DÉSIRANT, M. *Commun. K. Onnes Lab., Leiden* (*No.* 257*b*). *Physica, 's Grav.*, **8**, 273 (1941).—The atomic heats (calories/degree/gram atom) of 99·9% tantalum in the superconducting and in the normal state are:

	1·0	1·6	2·0	2·6	3·0	3·6	4·0	4·2°K
super.	0·00032	133	269	533	751	1172	1610	—
normal	0·00144	237	307	420	501	649	787	880

The normal state was maintained below the transition temperature by a magnetic field of 3 000 gauss; measurements made at smaller fields are also given. The change in the heat capacity is not sharp, extending from 3·955° to 4·155°K. Separation of the normal heat capacity into an elastic part, proportional to T^3, and an electronic part, proportional to T, indicates that the density of states in the 5*d* band is much greater than that given by the Fermi distribution for free electrons. A. J. C. W.

536.631 : 548.7 1617

Evaluation of specific heats of metals by the Born–Försterling method. DAYAL, B., AND SHARMA, R. S. *Proc. Indian Acad. Sci. A*, **21**, 218–21 (*May*, 1945).—The sp. hts. of Al, Cu, Ag, Pb, Au and Li were calculated from their elastic constants, by the use of a formula, originally given by Born and developed by Försterling. No agreement was found between the experimental data and the calculated values of the sp. hts., the latter being always much lower than the former.

536.655 : 536.48 1618

The heat of vaporization of Helium II below 1·5°K. HAGGENMACHER, J. E. *Phys. Rev.*, **69**, 242–3 (*March* 1 *and* 15, 1946).—A new expression is derived, in terms of the temperature, pressure and critical constants, which gives values agreeing with those of Bleaney and Simon [Abstr. 4108 (1939)].

536.7 : 532.71 *see Abstr.* 1539

536.71 : 530.145.65 *see Abstr.* 1511

536.8 : 621.4 = 3 1619

The use of light gases in closed circuit heat engines. ACKERET, J. *Schweiz. Bauztg*, **127**, 51–2 (*Feb.* 2, 1946) *In German.*—[Abstr. 1467 B (1946)].

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537 : 553.621 : 548.24 *see Abstr.* 1728

537.081.3 : 531.751.1 : 536.5.081.3 : 531.711 *see Abstr.* 1524

537.1 = 3 1620

Linear theory of the electron. II. BOPP, F. *Ann. Phys., Lpz.*, **42** (*Nos.* 7–8) 573–608 (1943).—*In German.*—[See Abstr. 1909 (1941)].—The main feature is the examination of the new degrees of freedom in relation to the possible variation of the field equations. A generalization of the Dirac presentation of the Maxwell quadripole potential forms the starting point. The general linear theory fits within the framework of the Mie–Born electrodynamics. The motion of the singular particles is such that the total Lorentz force of the intrinsic and external field disappears at the positions of the singularities. The principles of the general quantum electrodynamics are developed. The conditions for the reduction of the number of degrees of freedom are dealt with specially. H. G. S.

537.11 1621

On the current and the density of the electric charge, the energy, the linear momentum and the angular momentum of arbitrary fields. BELINFANTE, F. J. *Physica, 's Grav.*, **7**, 449–74 (*May*, 1940).—The author investigates the conditions which the Lagrangian for an arbitrary field must satisfy in order that the electric and current densities may be defined. Expressions for the angular and spin momenta and their densities are derived from the general principle of relativity. The author also discusses the ambiguities of the expressions for the charge and momenta due to the addition of and divergence to the Lagrangian integrand. He shows that charge and current are uniquely determined for a Lagrangian of the first order. The interaction terms with the Maxwell field then follow without ambiguity from the Lagrangian of the material part alone. In the case of a second order Lagrangian the total energy and the

total angular momentum are uniquely determined; but their densities are only uniquely defined if the Lagrangian is given in its general relativistic form. Even in this case the separation of orbital and spin parts of the angular momentum remains indefinite. The densities of the spin and the angular momentum are indefinite in all cases for a first order Lagrangian.

V. C. A. F.

537.122 1622

A note on accelerated electrons. FLIEZER, C. J. *Proc. Indian Acad. Sci. A*, **21**, 31–3 (*Jan.*, 1945).—From Dirac's relativistic equations of motion it is shown that the intrinsic energy of the electron is negative when the acceleration is positive, and as the electron acquires this negative energy it releases positive energy which supplies the increase in kinetic energy and loss of radiation. A transition from a positive to a negative energy state can occur in classical theory. The electron need not fall into the nucleus due to loss of energy by radiation. This energy can be supplied by subjecting the electron to an acceleration directed away from the nucleus.

W. R. A.

537.122 1623

Some criticisms of the theory of point electrons. LEWIS, T. *Phil. Mag.*, **36**, 533–41 (*Aug.*, 1945).—A criticism is made of Dirac's derivation of the equations of motion of an electron in an external radiation field [Abstr. 3660 (1938)]. Dirac deduced the equations from a variational principle [Abstr. 1742 (1942)], but it is now claimed that this deduction contains serious mathematical errors. It is further claimed that these errors appear also in a later paper [Abstr. 353 (1944)] where the equations of motion are expressed in terms of Poisson brackets. Some criticism is also made of Dirac's use of the Wentzel field and the λ-limiting process. In this the potentials are defined by

$$\mathbf{A}(\mathbf{x}) = \tfrac{1}{2}\{\mathbf{A}_w(\mathbf{x}+\boldsymbol{\lambda}) + \mathbf{A}_w(\mathbf{x}-\boldsymbol{\lambda})\}$$

subject to $(\mathbf{z}_i - \mathbf{z}_j \pm \boldsymbol{\lambda})^2 < 0, \quad i \neq j$

It is suggested that this condition be replaced by

$$(\mathbf{z}_i - \mathbf{z}_j \pm \boldsymbol{\lambda})^2 < 0, \quad \mathbf{x} \neq \mathbf{z}_i$$

and the consequences of this are examined. L. S. G.

537.122 1624

Classical theory of the point electron. SCHÖNBERG, M. *Phys. Rev.*, **69**, 211–24 (*March* 1 *and* 15, 1946).—The difficulties of the classical theory of the electron are examined and methods to eliminate them are given. It is shown that the whole theory can be derived from a division of the total field created by a point charge in two parts, one which reacts on the generating particle and accounts for the emission of radiation, another which does not react on the particle but acts on other particles. There are several types of motions of the particles depending on the kind of field they generate, fields which are always solutions of Maxwell's equations. Only three types of motions are, apparently, physically interesting: (*a*) motions with positive or (*b*) negative kinetic energy in which the particles radiate, and (*c*) radiationless motions analogous to the stationary motions of quantum theory. It is shown that the field picture of Faraday and Maxwell must be revised because not all the electric actions between particles can be considered as arising from their interaction with a field. The whole theory of the particles and the field can be derived from an action principle and boundary conditions for the equations of motion of the particles and the field.

537.122 : 530.145.6 *see Abstr.* 1505

537.122 : 538.3 : 530.145 1625

Quantum effects in the interaction of electrons with high frequency fields and the transition to classical theory. SMITH, L. P. *Phys. Rev.*, **69**, 195–210 (*March* 1 *and* 15, 1946).—The interaction of electrons with an electromagnetic field within a conducting enclosure is treated from the point of view of quantum mechanics. The various quantum effects to be expected with regard to energy exchanges are pointed out and it is shown how the various probabilities of energy change combine to give results in accord with classical theory for conditions where classical theory becomes appropriate. The details in the transition from quantum behaviour to classical behaviour are traced for two particular examples. The conditions under which quantum effects manifest themselves are given.

537.122 : 621.385.83 1626

Radiation losses in the induction electron accelerator. BLEWETT, J. P. *Phys. Rev.*, **69**, 87–95 (*Feb.* 1 *and* 15, 1946).—[Abstr. 1397 B (1946)].

537.122 = 4 1627

The radiation damping of the Dirac electron in asymptotic mechanics. STUECKLEBERG, E. C. G., AND BOUVIER, P. *C.R. Soc. Phys. Hist. Nat., Genève*, **61**, 162–5 (*April–July*, 1944) *In French.*—Previous authors have treated the radiation damping by the methods of rational quantum mechanics [Abstr. 2401 (1941)]. The problem is now studied by means of the asymptotic mechanics introduced earlier [Abstr. 1507, 1508 (1946)] and the results of the calculations (of various cross-sections, etc.) are compared with those of Wilson [Abstr. 2402 (1941)]. L. S. G.

537.123 1628

On the scattering of scalar mesons. HARISH-CHANDRA. *Proc. Indian Acad. Sci. A*, **21**, 135–46 (*April*, 1945).—The classical formulae for the scattering by a neutron are obtained taking account of the radiation damping. The neutron is assumed to possess a "charge" and a "dipole moment." The scattering due to each of these is treated separately. It is found that the formulae for the scattering due to the dipole have exactly the same form as the one obtained by Bhabha for the transverse mesons. Due to numerical factors the scattering for large energies of the incident mesons is double, and for small energies half that of transverse vector-mesons. The scalar and pseudo-scalar charge and dipole interactions are considered in the quantum theory. The scalar dipole interaction does not give rise to any scattering at all, the whole of the scattering being due to the pseudo-scalar interaction. In this case the quantum-theoretical formulae agree with the corresponding classical ones if the effect of radiation reaction is neglected in the latter.

537.123 1629

Concerning the anomalous scattering of mesotrons. SHUTT, R. P. *Phys. Rev.*, **69**, 128 (*Feb.* 1 *and* 51, 1946).—[See Abstr. 786 (1946)].

537.123 : 537.591 = 3 1630

The mass of the meson. RÜLING, J., AND STEINMAURER, R. *Experientia*, **2**, 108–9 (*March* 15, 1946) *In German.*—Measurement of cosmic radiation with a slowly expanding Wilson chamber indicates mesons of different masses. There are at least two different masses, one between $100\,m_0$ and $200\,m_0$ and the other exceeding $200\,m_0$.

537.123 : 539.185 *see Abstr.* 1695

537.132 1631

Further measurements concerning the production of positive electrons by beta particles. BARENDRECHT, F., AND SIZOO, G. J. *Physica, 's Grav.*, **7**, 490–501 (*June*, 1940).—Cloud chamber measurements were made of the number and the energy distribution of the positrons directly emitted by a UX-source and of those excited in Al and Pb by the β-particles of RaC and UX respectively. The coefficient of internal β-conversion for UX was 0·028. The effective cross-section for the external β-conversion is of the order 10^{-22} cm^2 and roughly proportional to the atomic number. In the internal as well as in the external conversion the chance that the positron obtains only a small part of the available energy is relatively high and seems to increase with the energy of the electrons.

537.133 : 530.145.6 1632

Relativistic wave equations for the proton. BHABHA, H. J. *Proc. Indian Acad. Sci. A*, **21**, 241–64 (*June*, 1945).—Expressions for the Lagrange function, energy tensor, and current vector are given. For particles of half odd integral spin the equations have to be quantized in accordance with the Fermi–Dirac statistics whilst for those with integral spin the Einstein–Bose statistics can be applied. The non-relativistic approximations of the equations are investigated. It is shown that the equation $\{\alpha^k p_k + \chi\}\psi = 0$, in which the α's are given by the irreducible representation $R_5(\frac{3}{2}, \frac{1}{2})$ of the Lorentz group in five dimensions, is a possible one for describing the behaviour of the proton. Non-relativistically the proton in its state of lowest rest mass would behave like a particle of spin $\frac{1}{2}$, and would have in addition one other state of rest mass three times the lowest value. Other equations given by the representation $R_5(n, \frac{1}{2})$ can be used to describe the proton if n is not too large, and in each case it behaves non-relativistically, like a particle of spin $\frac{1}{2}$, in its state of lowest rest mass. The proton should have several new physical features which would be manifest only at very high energies. W. R. A.

537.214 1633

On the electrical interaction between two charged spheres. DUBE, G. P. *Bull. Patna Sci. Coll. Phil. Soc.* (*No.* 12) 30–4 (*Dec.*, 1941).—The interaction energy between two charged spheres can be obtained by the application of the principle of electrical images. It may also be obtained from the Debye–Hückel equation for strong electrolytes. In the latter case the expression for the electrical potential at any point in the dispersion medium cannot be solved in general in the two-particle case, but a solution can be obtained when the two spheres are identical, and leads to the same expression as that obtained by the method of electrical images. The method can also be used for non-conducting spheres, where the expression includes the ratio of the permittivity of the particles to that of the dispersion medium. A. J. M.

537.226.2 1634

The dielectric constants of eight gases. HECTOR, L. G., AND WOERNLEY, D. L. *Phys. Rev.*, **69**, 101–5 (*Feb.* 1 *and* 15, 1946).—The permittivities of eight gases have been measured by a heterodyne beat frequency method. Special precautions were taken to improve minor defects in the equipment. Data on He, Ne, A, H_2, N_2, O_2, CO_2 and air are given and compared with the results of numerous other observers.

537.226.2 : 539.31 : 537.228.1 : 548.0 *see Abstr.* 1725

537.226.2 : 621.3.011.5 1635

Dielectric constants of some titanates. COURSEY, P. R., AND BRAND, K. G. *Nature, Lond.*, **157**, 297–8 (*March* 9, 1946).—[See Abstr. 3009 (1945)].

537.228.1 : 534.133 1636

A note on the even, odd and half-overtones in piezo-electric crystal plates. BHAGAVANTAM, S., AND SURYANARAYANA, D. *Proc. Indian Acad. Sci. A*, **21**, 19–23 (*Jan.*, 1945).—Conditions under which even and odd overtones of piezo-electric crystal plates may be excited have been investigated using tourmaline, quartz and spharelite plates. Non-uniformity of the electric field or of the crystal plate strongly excites the even overtones. Errors in orientation, and non-uniformity of the electric field or of the crystal plate, result in characteristic shear modes along with the appropriate even and odd harmonic. Any overtone of the shear mode is always of a lower intensity than the corresponding overtone of the longitudinal mode. No half-fundamental was detected. Certain frequencies previously attributed to odd overtones of a half fundamental are explained as the even and odd overtones of a shear mode. W. R. A.

537.228.1 : 537.226.2 : 539.31 : 548.0 *see Abstr.* 1725

537.228.1 : 621.396.662.3 1637

Piezo-electric crystals and their use in electrical wave filters. SCHERRER, P., AND MATTHIAS, B. *Brown Boveri Rev.*, **31**, 316–22 (*Sept.*, 1944).—[Abstr. 1438 B (1946)].

537.311.1 : 621.385 1638

A theory of valve and circuit noise. CAMPBELL, N. R., AND FRANCIS, V. J. *J. Inst. Elect. Engrs, Pt III*, **93**, 45–52 (*Jan.*, 1946).—[Abstr. 1388 B (1946)].

537.311.31 = 4 1639

Variation of the electrical conductivity of metallic cerium with temperature. FOËX, M. *C.R. Acad. Sci., Paris*, **219**, 117–18 (*July* 24, 1944) *In French.*—The resistance of thin rods of cerium (purity 99·6%) of diameter 1·2 mm and length 100–150 mm was measured in the temperature range −200°C to +300°C. Graphs of R/R^* against temperature are given for the β and γ forms, where R^* is the resistance at 300°C. There is a sharp drop in the value of R/R^* for temperatures below −98°C, and a hysteresis effect occurs. L. S. G.

537.312.5 : 535.37 1640

The photoconductivity of zinc-cadmium sulfide as measured with the cathode-ray oscillograph. HARDY, A. E. *Trans. Electrochem. Soc.*, **87** (*Prepr.* 27) 12 *pp.* (1945).—The use of the cathode-ray oscillograph for the measurement of photoconductivity is a major aid

in providing information leading to an interpretation of the mechanism of luminescence. The measurement of photoconductivity can be used in determining the excitation-absorption bands in the visible region where ordinary photometric methods are difficult due to the overlapping of emission and absorption. The measurement is very useful for investigating the optical quench characteristics under red-light or infra-red radiation. The conductance of fine crystals of ZnCdS : Cu, in a layer 60–80 μ thick, with an exposed area of 24 cm^2 is of the order of 10^{-8} mhos in the unexcited state, and during ultraviolet excitation it may rise to 3–4 $\times$ 10^{-8} mhos. CdS, Cu activated, which is said to be an infra-red-emitting phosphor, shows definite photoconductivity under red-light irradiation. Zn–CdS sulphide phosphors show a polarization and rectification effect.

537.312.6 1641

Negative resistance-temperature coefficient of thin evaporated films of bismuth. TULLEY, W. J. *Nature, Lond.*, **157**, 372 (*March* 23, 1946).

537.312.6 : 537.323 1642

The temperature coefficient of electrical resistance of ruthenium and its thermo-electric behaviour with respect to Pt. JAEGER, F. M., AND ROSENBOHM, E. *Proc. Ned. Akad. Wet.*, **44** (*No.* 2) 144–52 (1941).—The extreme hardness, brittleness, oxidizability and high m.p. (1 966°C) make it necessary to use as contacts ground Pt wires fitting into ground conical holes in the ends of the experimental bar which is made from powder by compression. The method is that previously described [Abstr. 2287 (1936)]. The thermo-electric experiments were carried out in an hermetically sealed steel cylinder, thin Pt wires forming a Pt–Ru–Pt differential couple. The temperature gradient along the wire is measured by a Pt–PtRh–Pt differential couple. The results are given in tabular and graphical form and are compared with the differential-heat capacity curve of Ru and Mo to fix transition points. There is an unexplained maximum in all the curves at 301°–312°C, and previous results for transition temperatures are confirmed as follows: $\alpha \leftrightarrows \beta$ 1 035°C, $\beta \rightleftarrows \gamma$ 1 190°C, $\gamma \rightleftarrows \delta$ 1 500°C. The similarity between Fe and Ru is emphasized. E. H. D.

537.312.62 1643

Superconductivity and magnetic energy between currents. BAND, W. *Phys. Rev.*, **69**, 241 (*March* 1 *and* 15, 1946).

537.312.62 1644

Diamagnetism and superconductivity. BAND, W. *Phys. Rev.*, **69**, 241 (*March* 1 *and* 15, 1946).

537.312.62 : 536.48 1645

An experiment on the mechanism of superconductivity. DAUNT, J. G., AND MENDELSSOHN, K. *Proc. Roy. Soc. A*, **185**, 225–39 (*Feb.* 12, 1946).—The object of the experiment was to investigate the hypothesis that superconductivity originates from some process of interaction either between the electrons in the metal or between the electrons and the periodic field of the lattice. The Thomson coefficient of superconductive Pb was measured experimentally and found to be zero. The conclusion is that the electrons engaged in a superconductive current remain energetically at absolute zero. The apparent electronic specific heat of a superconductor, assumed to be due to electron excitation from the lowest state, was found from magnetic data to vary as T^3. An empirical model of the electronic term system is suggested in which a small energy gap separates the upper limit of the Fermi distribution at absolute zero from a continuum of higher states. The number of superconductive electrons at absolute zero was calculated to be about 10^{-3} of the number of atoms. A similarity between the frictionless transport in superconductors and that in liquid He II is pointed out. It is concluded that the cause for both phenomena may be essentially the same—an aggregation of freely mobile particles of zero thermal energy which follows similar rules irrespective of the nature of the particles involved. L. S. G.

537.312.62 : 536.48 : 536.631 *see Abstr.* 1616

537.323 : 537.312.6 *see Abstr.* 1642

537.523.2 1646

Field emission of electrons. JENKINS, R. O. *Rep. Phys. Soc. Progr. Phys.*, **9**, 177–97 (1942–43).—A general description of the work carried out, during the past 25 years, on the extraction of electrons from cold metals by means of strong electric fields. Applications of quantum and wave mechanics to the theory are considered. Experimental work carried out during the years 1930–43 is reviewed and the field emission projection electron microscope is described in detail. Future trends are discussed briefly. L. S. G.

537.523.4 1647

Incomplete breakdown: a cathode de-ionization effect. JONES, F. L. *Nature, Lond.*, **157**, 480 (*April* 13, 1946).—Auto-electronic emission from the cathode during the breakdown, and not only in the pre-breakdown period, is shown to be a necessary factor for the complete breakdown of spark gaps in air at atmospheric pressure. With clean, smooth electrodes, the gap resistance rises again after the initial breakdown.

537.523.4 : 534.222.2 1648

Preliminary investigation of spark discharges along shock waves. HACKMAN, E. E. *Phys. Rev.*, **69**, 130 (*Feb.* 1 *and* 15, 1946).

537.525.5 1649

Cathode dark space and negative glow of a mercury arc. SMITH, C. G. *Phys. Rev.*, **69**, 96–100 (*Feb.* 1 *and* 15, 1946).—Means were evolved to observe the cathode dark space of the mercury arc, the object being to measure the thickness and evaluate therefrom the voltage gradient at the cathode to distinguish between field and emission theories of electron liberation. A magnetic field transverse to the arc drives it in the opposite direction to the force involved. This *wrong way* motion made it possible to race the arc spot over smooth mercury while ions, electrons, and vapour were blown rearward. Photomicrographs showed a negative glow, its image in the mercury, and a space between; evidently twice the dark space. A one-ampere arc had a dark space of 0·001 cm; a hundred times too large for the field theory, and causing excessive space charge limitation of current unless compensating ionization occurs throughout the said space. Phenomena in the negative glow must cause the needed ionization and also intensive electronic bombardment of the cathode. This is

assumed to cause cumulative excitation of the liquid resulting in emission of electrons and light. A continuous spectrum originates—within the limits of measurement—at the liquid.

537.531 : 535.072 1650

Large dispersion in X-ray spectrography obtained by using ground faces. AMINOFF, G. *Nature, Lond.*, **157**, 517 (*April* 20, 1946).

537.533.72 : 548.52 *see Abstr.* 1730

537.533.72/.73 : 669.018 1651

Investigation of secondary phases in alloys by electron diffraction and the electron microscope. HEIDENREICH, R. D., STURKEY, L., AND WOODS, H. L. *J. Appl. Phys.*, **17**, 127–36 (*Feb.*, 1946).—[Abstr. 1482 B (1946)].

537.533.73 : 535.243 : 531.714.2 *see Abstr.* 1525

537.533.74/.75 1652

Influence of intercrystalline forces on beta-ray absorption. RATHGEBER, H. D. *Phys. Rev.*, **69**, 239–40 (*March* 1 *and* 15, 1946).—No difference could be found between cold-rolled and annealed Al foils as regards absorption or scattering of RaD + RaE β rays [see Abstr. 99 (1946)].

537.533.9 1653

Electron bombardment as a means of material transfer. JACOB, L. *Nature, Lond.*, **157**, 586 (*May* 4, 1946).—Ba, Sr, Cs and Na were "sputtered" by bombardment with electrons of some hundreds of eV energy. They appeared to be emitted as positive ions, without rise in the body temperature of the target, though there was evidence of very localized heating.

537.534 : 621.385.82 1654

A device producing ion beams homogeneous as to mass and energy. KOCH, J. *Phys. Rev.*, **69**, 238 (*March* 1 *and* 15, 1946).—The effect of fluctuations of accelerating potential on the focusing of a conventional magnetic-deflection mass-spectrometer can be compensated by a small deflecting electrode placed near the entrance to the magnetic field. This electrode is connected (through a d.c. amplifier and suitable biasing circuits) to a tapping point on the h.t. supply, and gives a suitable deflection to ions faster or slower than the average to bring them to a fixed focus point. Accurate stabilizing of the h.t. supply is thus rendered unnecessary. By controlling the potential of the collecting electrode in the same way the impact energy of the ions can be maintained constant, if necessary.

537.542 : 539.16.08 1655

Recent research on counter tubes. CRAGGS, J. D. *Rep. Phys. Soc. Progr. Phys.*, **9**, 137–57 (1942–43).—Deals with new work on counter mechanisms carried out since 1938. Proportional and non-proportional counters are considered. A very extensive bibliography, largely of American literature, is appended.

L. S. G.

537.542 : 621.317.39 : 537.591 *see Abstr.* 1658

537.543 : 621.385.822.5 1656

Concerning some new methods of acceleration of relativistic particles. VEKSLER, V. *Phys. Rev.*, **69**, 244 (*March* 1 *and* 15, 1946).—Gives references to earlier papers by the author which describe the methods suggested by McMillan [Abstr. 806 (1946)]. A 30 eMV accelerator with varying magnetic field is now nearing completion in the Physical Institute of the Academy of Sciences, U.S.S.R.

537.562 = 4 1657

The conditions of ionization in the interior of an electrically neutral cloud. PLUVINAGE, P. *C.R. Acad. Sci., Paris*, **218**, 48–50 (*Jan.* 4, 1944) *In French.*—The cloud is supposed to consist of a large number of droplets per cm^3, charged under the action of atmospheric ionizing agents. The mobility k and diffusion coefficient d are taken to be equal for positive and negative ions. The radius of a droplet is a and $\eta = ek/da$ where e is the electronic charge. It is shown that the number, N_p, of droplets per unit volume having a charge pe, is given by

$$N_p/N_0 = (p\eta)^{-1}[\exp\{-\tfrac{1}{2}p(p-1)\eta\} - \exp\{-\tfrac{1}{2}p(p+1)\eta\}]$$

Using this an expression is obtained for the mean ionization density. L. S. G.

537.591 : 537.123 = 3 *see Abstr.* 1630

537.591 : 537.542 : 621.317.39 1658

Experimental arrangement for the measurement of small time intervals between the discharges of Geiger–Müller counters. ROSSI, B., AND NERESON, N. *Rev. Sci. Instrum.*, **17**, 65–71 (*Feb.*, 1946).—[Abstr. 1336 B (1946)].

537.591.1 1659

Analysis of cosmic-ray fine structure. I. Earlier Missouri observations. WARREN, D. T. *Phys. Rev.*, **69**, 78–87 (*Feb.* 1 *and* 15, 1946).—The present paper gives the results of an analytical study of directional intensity anomalies [see Abstr. 742, 2968 (1940)]. The observations are plotted on a log *vs.* log graph, a straight line being represented by a least-squares equation of the form, $j = A \sec^b \zeta$. The anomalous points fall below the line and are represented by a second line parallel to the first. The data of the two observers show excellent agreement. The least-squares constants of the calculated equations show a real but rather irregular azimuthal variation. Special consideration of the reported time fluctuations of these fine-structure anomalies shows that in practically no case are they distinguishable from statistical fluctuations in counting. The anomaly close to the zenith is shown to be caused by magnetic effects, and not atmospheric absorption. In the case of the other two anomalies, the importance of the secondary formation process is stressed. It must lead to an energy ratio S between the primary and mean secondary energies, the latter being concerned in the absorption. Comparison with the atom-annihilation results for the soft radiation suggests that the absorption anomalies, with $S = 2{\cdot}2$, may show agreement, but the magnetic anomaly, with $S \geqslant 1$, cannot agree. There is a slight suggestion here of two kinds of primaries, both involved in mesotron production.

537.591.1./2 : 539.185 1660

The energy distribution and number of cosmic-ray neutrons in the free atmosphere. KORFF, S. A., AND HAMERMESH, B. *Phys. Rev.*, **69**, 155–9 (*March* 1 *and* 15, 1946).—A neutron counter was carried to high elevations by a free balloon. It was found that

there are practically no thermal neutrons in the free atmosphere, in contrast to the fact that near the surface of the ground most of the neutrons are thermal. The number and the rate of production of the neutrons increases rapidly with elevation, in good agreement with previous measurements.

537.591.15 1661

Shower production by mesons in cosmic radiation. CHAKRABARTY, S. K. *Bull. Calcutta Math. Soc.*, **37**, 95–106 (*Sept.*, 1945).—Electrons and positrons may be (theoretically) produced by mesons in three ways: (1) *B*-shower. The meson produces a very fast secondary electron, by direct collision, and this subsequently produces a shower by cascade multiplication. (2) *C*-shower. The meson radiates a high energy quantum which later produces the shower. (3) *D*-shower. The meson decays and the decay products, which contain electrons, multiply according to the cascade process. Each of these three showers are considered. Attention is confined to small showers, in which the effect of the knock-on process predominates. Calculations are made of (*a*) the average number of electrons and positrons which accompany the passage of a meson of given energy, in cases (1) and (2), and (*b*) the probability of getting more than N particles either in a *B*- or *C*-shower, produced by a meson of given energy in traversing an infinitely thick layer of material. Finally the formation of *D*-showers is considered. The results of a previous paper [Abstr. 2205 (1943)] and the present one give a fairly complete theory of the shower generations by mesons, through all the different processes hitherto known in quantum mechanics.

L. S. G.

537.591.15 1662

The structure of cosmic-ray air showers. KINGSHILL, K. L., AND LEWIS, L. G. *Phys. Rev.*, **69**, 159–64 (*March* 1 *and* 15, 1946).—Bursts of ionization occurring in each of two thin-walled unshielded ionization chambers were measured at Chicago (elevation 190 m), with the same apparatus used at Echo Lake (elevation 3 100 m). A comparison of the size-frequency distribution curve for bursts occurring in a single chamber at Chicago with the corresponding curve observed at Echo Lake shows that the altitude dependence for bursts containing more than 50 particles is similar to the altitude dependence of large air showers measured with Geiger–Müller counters. In contrast to this, the altitude dependence for the largest bursts is much greater. The ratio of the coincident burst rate to the single chamber burst rate is as low at Chicago as at Echo Lake. If one assumes the validity of the cascade theory of showers and of the theory of multiple scattering of electrons in air, one must conclude from these data that showers exhibiting these narrow regions of high particle density cannot originate close to the top of the atmosphere. The data presented in this paper, together with the data of Lapp and of Carmichael, show that the slope of the size-frequency distribution curve for bursts in a single chamber is dependent upon the chamber wall.

537.591.15/.2 1663

The extensive cosmic ray showers and bursts. CLAY, J. *Physica, 's Grav.*, **9**, 897–907 (*Nov.*, 1942).—Experimental observations are described which can be explained on the assumption that the extensive showers are made up of clusters of electrons, of average number 6, accompanying mesons; the density of clusters and mesons alike falls off with distance. The electrons must be regarded as secondary effects of the mesons. The total energy of the shower is of the order of 10^{13} eV, and the number of the showers is in agreement with the relation $N = N_0E^{-2\cdot9}$. Arguments are presented for the view that Hoffman bursts are the same phenomenon as extensive showers.

537.591.15/.2 1664

The structure of extensive showers in cosmic rays. CLAY, J. *Physica, 's Grav.*, **11**, 311–26 (*Dec.*, 1945).—Different methods of investigating the clusters accompanying mesons [Abstr. 1663 (1946)] give a number of 10 electrons per meson. The diameter of these clusters depends on the material above the counters and its distance from them, and is 0·5–2 m. The existence of photons in the cluster, especially in the open air, is shown by the fact that a layer of 1·5 cm Pb above the counters gives a $10\times$ multiplication.

537.591.15/.2 = 393 1665

The energy in showers and impacts in cosmic radiation. CLAY, J. *Versl. Ned. Akad. Wet. Afd. Natuurk.*, **53** (*No.* 6) 365–74 (1944) *In Dutch.*—Ionization bursts and extensive showers, which are assumed to be due to identical causes [Abstr. 1663 (1946)], give an indication of particles of very high energy occurring in cosmic radiation. The results are given of the simultaneous recordings in four ionization-vessels of 22, 28, 40 and 40 l, over about 20 000 hours, of bursts of density $10^4 - 2\times10^5$ paths per m^2, occurring simultaneously in two or more vessels. The frequency of these bursts agrees with the integral energy spectrum found by absorption in thick layers of water, assuming that with increasing density of the paths the decrease of the frequency is smaller than for lower densities. This is connected with the fact that for the highest densities the frequency in the unprotected vessels is higher than in the protected, as opposed to the burst of lower densities. As in these bursts the shower is in the later stage of development the average energy of the particles is smaller than in the smaller burst where the energy is still more concentrated in the mesons, the penetrating part of the shower. Assuming that these concentrated bursts are part of an extended shower, it was shown that particles must exist having an energy of at least 5×10^{15} eV, but that their frequency is as low as 1 in 1 000 hrs/m^2.

537.591.5 1666

The semidiurnal variation of meson intensity. SARABHAI, V. *Proc. Indian Acad. Sci. A*, **21**, 66–72 (*Jan.*, 1945).—The diurnal variation in the cosmic ray intensity has been made using different counter arrangements. A semidiurnal variation of meson intensity, as measured by the method of shower coincidences, has been correlated with the semi-diurnal variation of pressure. An explanation in terms of meson decay and the nature of the daily atmospheric oscillations is suggested. W. R. A.

537.591.5 : 523.746 1667

Cosmic rays and the great sunspot group of January 29–February 12, 1946. DUFERIER, A., AND

McCaig, M. *Nature, Lond.*, **157**, 477 (*April* 13, 1946).

538.081.1 = 3 1668

The problem of the definition of magnetic moment and magnetization. Diesselhorst, H. *Elektrotech. Z. [ETZ]*, **62**, 497–9 (*May* 29, 1941) *In German.*

538.082.742 : 621.317.41 1669

A rapid cathode-ray method for the determination of low magnetic susceptibility. Convey, J., and Russell, O. J. *J. Sci. Instrum.*, **23**, 71–2 (*April*, 1946).—[Abstr. 1339 B (1946)].

538.213 = 3 1670

The dispersion of initial permeability. Snoek, J. L. *Physica, 's Grav.*, **7**, 515–18 (*June*, 1940) *In German.*—Carefully purified Fe in the annealed condition is shown to have, at frequencies of the order of 1 c/s, an initial permeability, which is many times higher than the initial permeability as determined from measurements of the skin effect at frequencies between 10^6 and 10^8 c/s. The present theory offers no explanation for this.

538.214 : 541.67 *see Abstr.* 1720

538.22 1671

On the interpretation of the magnetic anomalies of some salts of the iron group. Schultz, B. H. *Commun. K. Onnes Lab., Leiden* (*No.* 259*b*). *Physica, 's Grav.*, **7**, 413–31 (*May*, 1940).—An interpretation of the magnetic properties of the anhydrous salts of the iron group is discussed. It is based on the assumption of a partial ferromagnetism, and the experimental results given in two preceding papers [see Abstr. 902 (1940)] are shown to be compatible with this assumption. For some substances the ferromagnetic part of the magnetization is found to have very high coercive force. A certain possibility for this is discussed, in connection with a suggestion made by Landau.

538.22 : 621.318.22 1672

Magnetic materials. Robinson, F. E. *Marconi Rev.*, **8**, 125–35 (*Oct.–Dec.*, 1945).—[Abstr. 1348 B (1946)].

538.23 1673

Loss due to magnetic hysteresis in silicon-steel sheets. Velayos, S., and Sanchez-Giron, V. *Nature, Lond.*, **157**, 583–4 (*May* 4, 1946).—Steinmetz's law $W = \eta(B_{max})^k$ for the loss W in terms of maximum flux density of the loop, B_{max} was obeyed by 3 different sheets between 1 000 and 12 000 gauss, with $\eta \simeq 0{\cdot}001$ and $k \simeq 1{\cdot}6$. It was not applicable at low and high densities. A superimposed steady flux did not affect the loss.

538.245 : 548.0 1674

Orientation of ferromagnetic domains near a crystal surface. Schoenberg, D., and Wilson, A. J. C. *Nature, Lond.*, **157**, 548 (*April* 27, 1946).

538.3 : 530.145 *see Abstr.* 1502

538.3 : 530.145 : 537.122 *see Abstr.* 1625

538.3 : 531.51 ; 530.12 *see Abstr.* 1494, 1495

538.54 : 621.365.5 1675

Induction heating of hollow metallic cylinders. Gemant, A. *J. Appl. Phys.*, **17**, 195–200 (*March*, 1946).—[Abstr. 1378 B (1946)].

538.565 : 621.385.8 : 621.396.611.4 = 4 1676

Effect of an electron beam upon the resonant frequencies of an electromagnetic cavity. Kahan, T. *C.R. Acad. Sci., Paris*, **221**, 616–18 (*Nov.* 19, 1945) *In French.*—[Abstr. 1424 B (1946)].

538.565 : 621.396.611 1677

A new type of electrical resonance. Schneider, E. E. *Phil. Mag.*, **36**, 371–92 (*June*, 1945).—[Abstr. 1421 B (1946)].

538.565 : 621.396.611.4 = 4 1678

Calculation of the perturbed resonant frequency of an electromagnetic cavity (deformation of the boundary). Kahan, T. *C.R. Acad. Sci., Paris*, **221**, 694–6 (*Dec.* 3, 1945) *In French.*—A cylindrical cavity with circular cross section is considered and a small variation in the radius is allowed, $r = R + \Delta R$, so that the axial symmetry may be lost. A calculation is made of the change in wavelength. This is $\Delta\lambda/\lambda = \frac{1}{2}\Delta R/R$ if the section is deformed into an ellipse. The method of a preceding note [Abstr. 821 (1946)] is used to calculate the structure of the perturbed wave. Expressions are given for the amplitudes of the various harmonics and also for the dependence of the axial electric field on the radius and the angular co-ordinate. L. S. G.

538.569.4 : 539.13 : 535.343.4–14 *see Abstr.* 1583

538.615 : 535.332 *see Abstr.* 1571

538.615 : 535.338 *see Abstr.* 1573

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539.13 : 536.4.031 *see Abstr.* 1613

539.13 : 538.569.4 : 535.343.4–14 *see Abstr.* 1583

539.152.2 1679

Nuclear induction. Bloch, F., Hansen, W. W., and Packard, M. *Phys. Rev.*, **69**, 127 (*Feb.* 1 *and* 15, 1946).—A preliminary account is given of an experiment in which nuclear magnetic moments are measured by a magnetic resonance method. An oscillating magnetic field is superimposed at right angles to a constant field, and at a critical frequency, depending on the value of the constant field and the nuclear moment, an induced voltage can be detected in a coil with axis perpendicular to the two fields. The method has been tested successfully with the protons of water.

539.153 : 535.338.1 = 4 *see Abstr.* 1574

539.155.2 1680

"Industrial" separation of isotopes. Feldenkrais, M. *Nature, Lond.*, **157**, 481 (*April* 13, 1946).—Proposes the utilization of the differential mobility of ions in the electrostatic field of a Van de Graaf generator, the large surface of the electrodes and the high field being advantages.

539.155.2.08 1681

Mass measurement with a single field mass spectrometer. Ney, E. P., and Mann, A. K. *Phys. Rev.*, **69**, 239 (*March* 1 *and* 15, 1946).—Ion masses were measured in a Nier-type 60° mass spectrometer by observing the accelerating potentials needed to focus the ions in a constant magnetic field, the mass being proportional to the inverse of the potential. A value of $3{\cdot}97163 \pm 0{\cdot}00005$ was obtained for the He^4/H_1^1

mass ratio which agrees with Aston's later value. This was obtained by comparing H_2^{1+} ions with He^{4++}.

539.16.08 : 537.542 *see Abstr.* 1655

539.163.2 1682

A study of the alpha-particles from Po with a cyclotron-magnet alpha-ray spectrograph. CHANG, W. Y. *Phys. Rev.*, **69**, 60–77 (*Feb.* 1 *and* 15, 1946).—A description is given of an alpha-ray spectrograph, consisting of the Princeton cyclotron magnet and a Plexiglas deflection chamber, in which the alpha-particles can be bent into a semicircle of about 80 cm maximum dia. Three different methods of detection have been employed with Po α-particles, which agree fairly well with one another; the ordinary photographic method, the counting method, and the method of photographic tracks. The half-width of the main line under favourable conditions is less than ½ mm, which is equivalent to about 0·01 eMV. The intensities a few mm away from the maximum are less than 0·1% of the main line intensity. The track method reveals a series of weak groups in the low energy region of the main line of the Po α-particles, while in the high energy region no indication of any discrete group has been found. As far as energy and intensity are concerned, these weak groups of α-particles are generally compatible with the γ-rays from Po as measured by Bothe. However, their intensities are not in agreement with the current theory of α-decay, as can be seen from the abnormally large spin changes deduced from the theory for the different α-transformations, and also from the large deviation of the Geiger–Nuttall curve for these groups from the curve for the members of the Ra family. Possible explanations of these short-range α-particles from Po have been suggested and discussed.

539.163.2 1683

The low energy β-spectrum of Cu^{64}. LEWIS, H., AND BOHM, D. *Phys. Rev.*, **69**, 129–30 (*Feb.* 1 *and* 15, 1946).—The significance of recent measurements [Abstr. 545 (1946)] for the Fermi theory of β-decay is pointed out, as they can only be explained by using two particular linear combinations of interactions, which would predict incorrect results for other nuclear data on other nuclei. It is of interest therefore to see whether the Cu^{64} nucleus is unique in respect to its low-energy β-spectrum.

539.163.2 = 4 1684

Energy spectra of high energy β- and γ-rays studied by means of the spectrometer with magnetic focusing. MAGNAN, C. *Ann. Phys., Paris*, **15**, 5–58 (*Jan.–March*, 1941) *In French.*—A spectrometer with magnetic focusing used in conjunction with one or more Geiger–Müller counters can be employed for the determination of the energy of γ-rays. The unsuitability of other methods, e.g. the rotating crystal method, is discussed. The method is used for the study of the energy spectra of positrons emitted by substances bombarded with α-rays from a weak Po preparation, and the three γ-rays emitted by the nuclear reaction $_{17}Cl^{35}(\alpha,p)\,_{10}A^{58}$ have been measured. The maximum energy of the positrons from P^{30} is 3·5 eMV, from Na^{22} 0·4 and 0·6 eMV, and from Al^{26} 4·6 eMV. The spectrometer has also been used in conjunction with two counters in coincidence, in the neighbourhood of a 300 kV neutron generator. In spite of the high energy neutrons it was possible to measure the γ-radiation emitted and a series of high-energy lines has been found. A. J. M.

539.163.2.08 1685

Ionization and straggling of Po α-particles in hydrogen and helium. RUTGERS, G. A. W., AND MILATZ, J. M. W. *Physica, 's Grav.*, **7**, 508–14 (*June*, 1940).—Measurements were made of the specific ionization of Po α-particles in H_2 and He by means of an ionization chamber, combined with a pulse amplifier. The Bragg curve obtained for hydrogen differs from that determined by Joliot and Onoda with an electrometer and is in agreement with the measurements of the loss in energy by Mano. The extrapolated ionization range in H_2 amounts to 172 mm, in He to 215 mm. The straggling parameters of the ranges are 2·1 and 2·7 mm respectively, after correction for the thickness of the source.

539.163.2.08 : 778.34 1686

The application of the photographic method in β ray spectroscopy. LANGENDIJK, W., AND ORNSTEIN, L. S. *Physica, 's Grav.*, **7**, 475–84 (*May*, 1940).—A description of a photographic method for measuring the intensity distribution in β ray spectra, and some experimental results concerning the photographic action of β-rays on the photographic plate, together with a discussion of these results. Possibilities and limitations of the method are considered.

539.164.93 1687

An experimental comparison of the chemical effects of deuterons and of alpha particles on methane and *n*-butane. HONIG, R. E., AND SHEPPARD, C. W. *J. Phys. Chem.*, **50**, 119–43 (*March*, 1946).—The principal gaseous products from both types of bombardment were paraffin hydrocarbons and hydrogen. The larger quantities of liquid obtained from the deuteron bombardments were distilled and the resulting cuts studied. A wide range in molecular weights is indicated. Evidence is obtained for the presence of olefine and ring structures. The mean energy dissipated per molecule decomposed is computed in all cases; its use eliminates difficulties encountered in calculations of ionization. While it is obviously impossible to prove the complete identity of the chemical effects of deuterons and alpha particles, these effects are very similar. Thus it appears that the deuteron beam is a valuable adjunct to naturally radioactive sources, especially where large amounts of conversion products are required.

539.164.93 1688

A theoretical analysis of the relative chemical effects of alpha particles and deuterons. SHEPPARD, C. W., AND HONIG, R. E. *J. Phys. Chem.*, **50**, 144–52 (*March*, 1946).—A review is made of the existing information concerning the manner in which the energy of the incident particles is distributed in the reacting system. Evidence is presented which indicates that the energy absorption is predominantly an electronic process, and that the energy is distributed among the various states of excitation and ionization of the reacting system in a manner which is inde-

pendent of the charge and mass of the bombarding particle and only slightly dependent on its velocity. An explanation is advanced for the frequently observed fact that chemical reactions occur in proportion to the ionization produced in the system.

539.167.3 1689

Radioactive Te from Sb bombardment. EDWARDS, J. E., AND POOL, M. L. *Phys. Rev.*, **69**, 140–4 (*March*, 1946).—A radioactive isomer has been found in Te^{121} with the help of a curved crystal X-ray spectrograph. The pair consists of a new 17 ± 1-day activity produced by the reactions Sb (d, $2n$) and Sb (p, n) and a previously assigned activity evaluated here as 143 ± 5 days. Sb and Te X-rays, a 0·61 eMV γ-ray, a 0·223 eMV γ-ray, and conversion electrons are associated with the long period. Sb X-rays and a 0·61 eMV γ-ray are associated with the short period. The observations are simply explained by the isomeric transition. No evidence of the "fast" λ-transition was found.

539.172.3 : 539.185 1690

Neutron yields from the photo- and electro-disintegration of beryllium. WIEDENBECK, M. L. *Phys. Rev.*, **69**, 235 (*March* 1 *and* 15, 1946).

539.172.3 = 3 1691

The nuclear photo effect with lithium-gamma radiation. II. HUBER, O., LIENHARD, O., AND WÄFFLER, H. *Helv. Phys. Acta*, **17** (*No.* 3) 195–214 (1944) *In German.*—A continuation of previous work [Abstr. 1123 (1946)]. Measurements were made of the nuclear photo effect in the case of the following isotopes: $_{14}Si^{28}$, $_{22}Ti^{46}$, $_{24}Cr^{50}$, $_{26}Fe^{54}$, $_{28}Ni^{58}$, $_{29}Cu^{63}$, $_{29}Cu^{65}$, $_{32}Ge^{72}$, $_{32}Ge^{76}$ and $_{37}Rb^{87}$. The relative yields for these isotopes, produced by (γ, n)-processes, were found to be 2·6 ± 0·5, 7·4 ± 1, 9 ± 2, 31 ± 3, 3·9 ± 0·7, 2·3 ± 0·4, 24 ± 3, 5·5 ± 1 and 53 ± 10 respectively. A new radioactive isotope of Cr was found. L. S. G.

539.172.4 1692

Fast neutron resonance with nitrogen. VALENTE, F. A., AND ZAGOR, H. I. *Phys. Rev.*, **69**, 55–9 (*Feb.* 1 *and* 15, 1946).—Studies of the $_7N^{14}(n, \alpha)$ $_5B^{11}$ reaction indicate the emission of heavy particle groups possibly as a result of resonance transmutation by fast neutrons from a Ra–Be source. When a nitrogen absorber is placed before the nitrogen detector, the heavy particle groups apparently do not appear. Upon interposition of carbon as a retarding material between nitrogen absorber and detector, the reappearance of some of the groups in question occurs. This behaviour would appear to indicate that nitrogen has a larger than normal probability of undergoing transmutation by certain fast neutron groups. Two interpretations suggest themselves: (1) the experimental points, while based on more than 100 000 pulses, possess statistical fluctuations sufficient to produce the observed apparent resonance phenomena for fast neutrons, or (2) nitrogen has a fast neutron absorption cross section of the order of 60×10^{-24} cm^2, much larger than the theoretical upper limit of about $0{\cdot}7 \times 10^{-24}$ cm^2. The resonance interpretation is supported by supplementary evidence. Further development of these techniques should make it possible to (1) estimate widths of nuclear levels, (2) measure nuclear energy levels, (3) check the reality of observed groups, and (4) determine which isotope is responsible for a group. Additional investigation of the subject is indicated.

539.185 1693

The scattering of slow neutrons by ortho- and paradeuterium. HAMERMESH, M., AND SCHWINGER, J. *Phys. Rev.*, **69**, 145–54 (*March* 1 *and* 15, 1946).—Theoretical formulae have been derived for the cross sections of the various transitions among the molecular rotational levels, which involve the scattering amplitudes $a_{\frac{3}{2}}$ and $a_{\frac{1}{2}}$ for the two spin states of the neutron-deuteron system. In particular, numerical results are given for the first few transitions originating from the ground levels of the ortho- and para-systems with neutron energies not exceeding 0·05 eV. The influence of the thermal motion of the molecule is described, and explicit formulae are given for the important transitions occurring at small neutron energies, on the assumption that the D_2 is in gaseous form at low temperature. The ratio of the ortho- and para-cross sections, under these conditions, is examined in its dependence upon the ratio of the scattering amplitudes. If the scattering amplitudes are of the same sign, the cross-section ratio is never greater than 1·31 and attains this magnitude only for small values of $a_{\frac{3}{2}}$ relative to $a_{\frac{1}{2}}$. If, however, the amplitudes are of opposite sign, this ratio can be as large as 1·75 and always exceeds 1·11. This experiment measures only the magnitudes of the amplitude combinations $(2a_{\frac{3}{2}} + a_{\frac{1}{2}})$ and $(a_{\frac{3}{2}} - a_{\frac{1}{2}})$, but not their signs, and thus leaves a fourfold ambiguity in interpretation.

539.185 1694

The albedo of thermal neutrons. AGENO, M. *Phys. Rev.*, **69**, 241–2 (*March* 1 *and* 15, 1946).

539.185 : 537.123 1695

Neutron and negative proton. WANG, K. C. *Nature, Lond.*, **157**, 549 (*April* 27, 1946).—The negative proton whose discovery was recently reported by Kapitza may be the product of $\beta+$ decay of a free neutron. Its annihilation with a positive proton would produce a 10^9 eV photon which should be easily detected. [See Abstr. 3072 (1945)].

539.185 : 537.591.1/.2 *see Abstr.* 1660

539.185 : 539.172.3 *see Abstr.* 1690

539.185.7 : 578.088.5 1696

Fast neutron energy absorption in gases, walls, and tissue. AEBERSOLD, P. C., AND ANSLOW, G. A. *Phys. Rev.*, **69**, 1–21 (*Jan.* 1 *and* 15, 1946).—The ionization produced by a beam of fast, γ-free neutrons was measured for various hydrogenous and non-hydrogenous gases at pressures from 3 mm to 3 atmospheres; and for various hydrogenous and non-hydrogenous counter wall materials. The results enable the rate, E_j, at which energy is transferred from the neutron beam to other nuclei, to be calculated (and also the mean scattering and absorption and disintegration cross section of the neutrons). These results are then applied to determine the relation between the effective neutron dose in various biological tissues and the quantity measured in ionization chambers of different designs and with different wall materials.

STRUCTURE OF SOLIDS 539.2

539.211 : 539.62 : 620.191 1697

State and properties of metallic surfaces. *Nature, Lond.*, **157**, 271–2 (*March* 2, 1946).—A report of the Paris conference, Oct. 23–26, 1945.

539.217.3 : 676 1698

Instrumentation studies. LI. Penetration of papers by water vapour. V. Methods for measuring vapour and gas permeability. *Paper Tr. J.*, **121**, 68, 74, 78, 80, 86, 91 (*Sept.* 27, 1945).—A bibliographical study, comprising abstracts of papers dealing with the measurement of the permeability of papers and other materials to various gases and vapours. J. G.

539.217.3 : 676 1699

Instrumentation studies. LII. Penetration of papers by water vapour. VI. *Paper Tr. J.*, **122**, *TAPPI Sect.*, 1–10 (*Jan.* 3, 1946).—The test specimen is sealed between a space of constant high R.H., and a narrow space of variable R.H. communicating with a large space (e.g. a room) of known and constant R.H., through a diffusion resistance, which may be adjusted so as to obtain a standard R.H. in the small space; this is measured by a small electric hygrometer. The water-vapour permeability is expressed in terms of the setting of the diffusion resistance. Alternatively, the diffusion resistance may be set at infinity and the rate of increase of the R.H. in the narrow space (due to permeation of water vapour through the sample) measured on the hygrometer. For a given paper there is satisfactory correlation between these methods and the usual gravimetric methods, but the former are far more rapid. J. G.

539.217.3 : 676 1700

Instrumentation studies. LIV. Penetration of papers by water vapour. VIII. Controlled relative humidity cabinet in which specimens may be weighed without removal from the conditioned atmosphere. *Paper Tr. J.*, **122**, *TAPPI Sect.*, 81–6 (*Feb.* 21, 1946).—A selector device, operated from outside the cabinet, is described for depositing the cups to be weighed, as required, on a fork supported from the arm of a balance situated outside the cabinet. Detailed technique for sealing and operating the cabinet, for controlling the R.H. of the cabinet by means of sat. salt solutions, and for the measurement of the R.H. by the dew point, wet and dry bulb thermometer and electric hygrometer methods, is described. J. G.

539.217.5 : 676 1701

Determination of the air resistance of paper. *Paper Tr. J.*, **121**, *TAPPI Sect.*, 223–4 (*Dec.* 6, 1945).—The apparatus consists of an outer vertical cylinder partly filled with a light spindle oil, and an inner cylinder which can slide freely up and down inside it on guide tracks. The conditioned paper sample is clamped so as to close the top of the inner cylinder, the bottom of which is open. The test is made by timing the rate of fall of the inner cylinder through an appropriate height, i.e. depending on the air-resistance of the paper. The greater this resistance the slower is the rate of fall. An average of 10 tests, 5 with each side of the paper uppermost, is taken. The average time (sec) for 100 ml of air to be displaced through 1 m^2 of paper is recorded. The reproducibility varies from 5 to 10% for 40 to 300 sec, respectively. J. G.

539.264 1702

Measurement and analysis of small-angle X-ray scattering. JELLINEK, M. H., SOLOMON, E., AND FANKUCHEN, I. *Industr. Engng Chem.* (*Analyt. edit.*) **18**, 172–5 (*March*, 1946).—Geiger counter methods can be used effectively for the recording of small-angle X-ray scattering in the study of inhomogeneities in substances in the range of 10 to 200 Å. A graphical method of analysing the data is presented and the results of such an analysis are given for one specimen each of γ-alumina and carbon black.

ELASTICITY . STRENGTH RHEOLOGY 539.3/.8

539.3 1703

The structure and elasticity of rubber. TRELOAR, L. R. G. *Rep. Phys. Soc. Progr. Phys.*, **9**, 113–36 (1942–43).—The relationship of the elastic and other states of rubber to the properties of the molecule and the arrangement of the molecules in the material is discussed. There is a long bibliography. L. S. G.

539.31 : 537.228.1 : 537.226.2 : 548.0 *see Abstr.* 1725

539.31 : 549.211 : 548.0 *see Abstr.* 1726

539.37 1704

Compatibility of stress and strain in yielded materials. SWAINGER, K. H. *Phil. Mag.*, **36**, 443–73 (*July*, 1945).—Generalized stress-strain relationships that apply beyond the elastic range of metals are developed. Known experimental results relating to strain in a metal specimen under simple tension or compression or under complex principal stresses are discussed and used as a basis for the new theory. Inelastic deformation is regarded as being built up by the superposition of an elastic component and a plastic component of strain. A function, P, of strain is introduced and P is the slope of the simple tensile stress-strain curve after yield has begun. Non-linear equations result if the complete stress-strain curve is expressed in closed form. But if P is constant the expressions are greatly simplified. Strain equations are obtained and these include the usual forms of elasticity theory as special cases. Plane stress due to pressure in a circular hole in a large plate is considered fully. An example discussed concerns a hole in a Duralumin plate. L. S. G.

539.373 1705

A theoretical criterion for the initiation of slip bands. ZENER, C. *Phys. Rev.*, **69**, 128–9 (*Feb.* 1 *and* 15, 1946).

539.374 : 539.893 1706

Studies of plastic flow of steel, especially in two-dimensional compression. BRIDGMAN, P. W. *J. Appl. Phys.*, **17**, 225–43 (*April*, 1946).—The experimental methods are described by which rectangular blocks were subjected to 2-dimensional compressional stresses and at the same time flow was maintained 2-dimensional with deviations of less than 1%. Within this range of flow a rather wide range of stress conditions is possible, so that the equations of plastic flow can be examined over a correspondingly wide range of conditions. It was found that 2-dimensional

flow is much more sensitive than 3-dimensional flow to shearing instabilities initiated at the edges where there are singularities in the mathematical solution. The transverse stress X_x required to maintain 2-dimensional flow is consistently higher than the theoretical value $\frac{1}{2}Z_z$; for some materials the excess above the theoretical value may rise to as much as 20%. This indicates a failure of the fundamental condition of isotropy of flow, which may be demonstrated in other ways. The time rate of primary flow was studied at various points on the strain-hardening curve. The rate of flow rises rapidly as the stress increases above the limiting strain-hardening curve. The rate of increase of the rate of flow for a given displacement from the limiting curve is much greater in the early stages of flow, which makes possible the calculation of the rate of propagation of a plastic disturbance from the parameters of the static strain-hardening curve. Beyond the early stages, the flow loses its smoothness and becomes jerky. At high strains, flow may not start at once when the load is increased, but there may be an initiation period during which flow is built up. The application of the results to the generalized strain-hardening curve is discussed.

539.4.019 : 666.115 1707

The effect of water on the strength of glass. BAKER, T. C., AND PRESTON, F. W. *J. Appl. Phys.*, **17**, 179–88 (*March*, 1946).—The strength of glass was measured in various surrounding media. It was found that glass is 20% stronger when dry than when wet, and 2–2½× as strong when baked in vacuum than when tested wet (on tests of 10 sec duration). Apparently, the chief cause of the loss of strength, as compared with that in vacuum, is moisture, but gases, especially CO_2, seem to have some effect. It was found that fatigue of glass disappears when the glass is tested in a vacuum. Autoclaving tests showed that glass is rapidly etched by water at higher temperatures, and that even silica glass is considerably attacked. It appears that the attack of water on glassy surfaces produces gels, and this attack goes on inside the flaws, thus considerably complicating the problem of the strength of glass.

539.4.019.1 : 666.115 1708

Fatigue of glass under static loads. BAKER, T. C., AND PRESTON, F. W. *J. Appl. Phys.*, **17**, 170–8 (*March*, 1946).—Static loading tests were run on glass and porcelain rods $\frac{7}{32}$ in. in diameter for times ranging in duration from 0·01 sec to 24 h, using the apparatus of Abstr. 1234 B (1946). It was found that glass can support for 0·01 sec about 3× the stress that would break it in 24 h. The effects are generally the same for all glassy materials. Porcelain showed the effect somewhat less than glass. It appeared that adsorbed moisture and gases reduced the strength.

539.4.019.1 : 666.115 1709

The fatigue modulus of glass. GLATHART, J. L., AND PRESTON, F. W. *J. Appl. Phys.*, **17**, 189–95 (*March*, 1946).—The decline in the breaking strength of glass with an increase in the length of time it is under stress has been noted by various experimenters. Based on the experimental results of Abstr. 1708 (1946), an empirical relationship is obtained which indicates that the reciprocal of the breaking stress is a linear function of the logarithm of the duration of the stress. Certain implications of this relationship are discussed.

539.4.019.1 : 666.115 : 620.174.24 1710

Wide range static strength testing apparatus for glass rods. BAKER, T. C., AND PRESTON, F. W. *J. Appl. Phys.*, **17**, 162–70 (*March*, 1946).—[Abstr. 1234 B (1946)].

539.434 1711

Creep of metals. ALLEN, N. P. *Nature, Lond.*, **157**, 469–71 (*April* 13, 1946).—Report of a conference, with contributions on measurement, empirical expressions for creep, theoretical hypotheses and expressions, the influence of metallurgical structure, with general discussion.

539.53 = 3 1712

Mechanical strength as an electron effect. SCHWAB, G. M. *Experientia*, **2**, 103–5 (*March* 15, 1946) *In German.*—The Brinell hardness of Hume-Rothery alloys depends on their electron concentration in the same way as do catalytic activation energy and electric resistivity. A wave-mechanical theory of hardness, based on the more or less total completion of the Brillouin-zones, is proposed.

539.62 : 620.191 : 539.211 *see Abstr.* 1697

539.893 : 539.374 *see Abstr.* 1706

539.893 : 551.14/.16 1713

A hypothesis on compressibility at pressures of the order of a million atmospheres. BULLEN, K. E. *Nature, Lond.*, **157**, 405 (*March* 30, 1946).

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.121/.128

541.122.4 : 533.73 *see Abstr.* 1546

541.124 : 77.012 *see Abstr.* 1754

541.126 : 662.21 = 3 1714

Gas and dust explosions. STETTBACHER, A. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 325–33 (*Nov.*, 1945) *In German.*—The maximum explosive energies are calculated for the first time for the most important gases (hydrogen, methane, acetylene, heptane) and dusts (carbon, sulphur, aluminium, magnesium, cane sugar, starch) in admixture with air and oxygen, and compared with known explosives data. An interpretation is then given of mysterious gas explosions, and of the potential dangers inherent in dust-laden atmospheres. The problem of the connection between the explosion disruptive pressure and the detonation velocity for the case of endothermic acetylene is considered. H. H. HO.

541.127 1715

The thermal decomposition of hydrogen peroxide vapour. MACKENZIE, R. C., AND RITCHIE, M. *Proc. Roy. Soc. A*, **185**, 207–24 (*Feb.* 12, 1946).—The decomposition of H_2O_2 vapour at pressure less than

1 mm in silica vessels was investigated over a temperature range 15–140°c, but mostly at 80°c. The results are: (1) Low pressures. O_2 has no appreciable influence on the rate of decomposition but H_2O vapour retards the rate slightly. The reaction is mostly a surface one. In one vessel the decomposition was bimolecular with respect to the peroxide pressures, the rate being given by $k[H_2O_2]^2/(1 + b[H_2O])^2$; in another the bimolecular reaction of the final stages at low peroxide pressures was preceded by one of approx. 0·7 at the high pressures. (2) Higher pressures. O_2 and N_2 retarded the decomposition appreciably. In H_2O vapour a periodicity in rate was evident. (3) The velocity of decomposition, calculated for 1 mm pressure of H_2O_2 at 50°c, was $0{\cdot}70 \times 10^{13}$ mol/cm²/sec, in agreement with the experimental value. L. S. G.

ELECTROCHEMISTRY 541.13

541.132 1716

Orientation of water molecules round charged particles. VAN ELTEREN, J. F. *Proc. Ned. Akad. Wet.*, **44** (*No.* 8) 930–2 (1941).—The potential energy of the H_2O molecules in relation to a charged particle was computed with reference to the radius of the charged particle. A graph shows differences in the behaviour of the F ion compared with Cl, Br and I ions. In the case of an equal ionic radius, positive ions seem to bind the H_2O molecules more strongly than negative ones. The possibility of computing hydration energies, taking account of various correcting factors, is proposed. N. M. B.

541.138 1717

A new type of electrochemical reaction. STARECK, J. E. *Trans. Electrochem. Soc.*, **89** (*Prepr. No.* 6) 6 *pp.* (1946).—The reaction was first observed while studying anodic conversion coatings on Zn from chromate baths. Under certain conditions electrochemical and chemical reactions proceed simultaneously and mutually assist each other during electrolysis. This type of reaction falls in the class of irreversible cells with soluble or active electrodes. Examples of anomalous reduction at the anode and of oxidation at the cathode are given. A theory is developed to explain the experimental observations.

COLLOIDS . ADSORPTION 541.18

541.182.02 1718

Preparation of electron microscope specimens for determination of particle size distribution in aqueous suspensions. CRAVATH, A. M., SMITH, A. E., VINOGRAD, J. R., AND WILSON, J. N. *J. Appl. Phys.*, **17**, 309–10 (*April*, 1946).—Small droplets of the suspension to be examined are deposited from a mist upon a specimen film whose surface has been treated to promote wetting by the droplets. This procedure makes the entire residue left by a whole droplet available for examination and promotes uniform dispersion of the deposit.

541.182.2 : 531.717.1 *see Abstr.* 1526

CHEMICAL STRUCTURE 541.2/.6

541.24 : 535.51 : 535.435 *see Abstr.* 1599

541.575 1719

Validity of Gurwitsch's rule. FOSTER, A. G. *Nature, Lond.*, **157**, 340–1 (*March* 16, 1946).

541.67 : 538.214 1720

Diamagnetism and chemical bonding. ANANTAKRISHNAN, S. V. *Proc. Indian Acad. Sci. A*, **21**, 114–22 (*March*, 1945).—Using the method of Gray but with the values of ionic susceptibilities derived by Slater's method, bond depression values have been set up for various linkages. With these values, the molar susceptibility of a large number of compounds have been calculated and a close agreement between the calculated and observed values is obtained. An empirical correlation is found between bond-order and bond-depression and the results clearly indicate the double bonded character of certain C–C and C–halogen linkages. A method of evaluating ionic susceptibilities using NH_4 and NO_3 ions as standards is indicated.

CHEMICAL ANALYSIS 543/545

543.812 : 621.317.39.029.5 1721

Radio-frequency dielectric properties of dehydrated carrots. Application and moisture determination by electrical methods. DUNLAP, W. C., JR., AND MAKOWER, B. *J. Phys. Chem.*, **49**, 601–21 (*Nov.*, 1945).—[Abstr. 1338 B (1946)].

545.372 1722

A dropping mercury electrode of improved sensitivity. RICHES, J. P. R. *Nature, Lond.*, **157**, 520 (*April* 20, 1946).

545.72 : 551.510.41 *see Abstr.* 1744

545.82 : 535.343.3 1723

The analysis of multicomponent mixtures of hydrocarbons in the liquid phase by means of infra-red absorption spectroscopy. FRY, D. L., NUSBAUM, R. E., AND RANDALL, H. M. *J. Appl. Phys.*, **17**, 150–61 (*March*, 1946).—The procedure is calibrated by measuring optical densities of synthetic standard samples. A constant thickness cell is used for both standard and unknown samples. Two procedures for converting optical densities to concentrations are described. Examples are given for four- and five-component mixtures. Data are presented to show the reproducibility of repeated measurements of optical density on the same sample, and results are given to show the agreement between the infra-red analyses and the known composition of synthetic mixtures.

545.822 : 535.33.072 = 3 1724

Rapid spectrographic analysis. ROHNER, F. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 311–17 (*Oct.*, 1945) *In German.*—Describes a technique for rapid spectrographic analysis, using ciné-film. The process is speeded at every stage by a considerable degree of mechanization and in this way it is possible to complete a group of five analyses of 3 elements in 20 minutes. J. W. T. W.

545.824 : 548.73 *see Abstr.* 1739

CRYSTALLOGRAPHY 548

548.0 : 538.245 *see Abstr.* 1674

548.0 : 539.31 : 537.228.1 : 537.226.2 1725

The elastic, piezoelectric, and dielectric constants of potassium dihydrogen phosphate and ammonium dihydrogen phosphate. MASON, W. P. *Phys. Rev.*, **69**, 173–94 (*March* 1 *and* 15, 1946).—Measurements have been made of all the elastic, piezoelectric and dielectric constants of KDP and ADP crystals through temperature ranges down to the Curie temperatures. The piezoelectric properties agree well with Mueller's phenomenological theory of piezoelectricity [Abstr. 1987 (1940)] provided the fundamental piezoelectric constant is taken as the ratio of the piezoelectric stress to that part of the polarization due to the hydrogen bonds. It is found that the dielectric properties of KDP agree well with Slater's theory, based on the interaction of the hydrogen bonds with the PO_4 ions [Abstr. 636 (1941)]. ADP undergoes a transition at −125°c which results in fracturing the crystal. This transition cannot be connected with the H_2PO_4 hydrogen bond system which controls the dielectric and piezoelectric properties, for these lie on smooth curves that do not change slope as the transition temperature is approached. It is suggested that two separate and independent hydrogen bond systems are involved in ADP. The transition temperature and specific heat anomaly appear to be connected with hydrogen bonds between the nitrogens and the oxygens of the PO_4 ions, while the dielectric and piezoelectric properties are controlled by the H_2PO_4 hydrogen bonds.

548.0 : 539.31 : 549.211 1726

Elastic constants of diamond. BORN, M. *Nature, Lond.*, **157**, 582 (*May* 4, 1946).—An identity connecting the 3 elastic constants and the main lattice vibration frequency has been obtained by a reconsideration of Nagendra Nath's theory [Abstr. 550 (1935)] of the action of second neighbour as well as first neighbour atom on the vibration of a C atom in the diamond lattice. This is not satisfied by the experimental values of Bhagavantam [Abstr. 310 (1945)] whose confirmation of Nagendra Nath's theory is here stated to be accidental. The theory of the vibrations of the diamond lattice is briefly discussed.

548.1 : 519.4 = 4 1727

The eigenphenomena of crystalline media. FOKKER, A. D. *Physica, 's Grav.*, **7**, 385–412 (*May*, 1940) *In French.*—A phenomenon unchanged, except for a numerical factor, by the operation of a symmetry element is called an eigenphenomenon and the factor an eigenvalue of the element. If the symmetry element is of the *n*th order the factor is an *n*th root of unity. Linear combinations of symmetry operations can be devised that decompose any phenomenon into eigenphenomena of the symmetry elements of the crystallographic group. The name "crinone" is proposed for such a combination; there are as many crinones as there are symmetry elements in the group. Crinones of complex groups can be expressed as products of crinones of the sub-groups ("merocrinones"). A "complete" crinone is eigen for all symmetry elements of the group. If the symmetry elements are commutative a crinone acting on itself reproduces itself; acting on any other it destroys it. If the symmetry elements are not commutative the crinones are grouped in "crinidies." A crinone acting on another of the same crinidie reproduces itself; acting on crinones of other crinidies it produces a crinone of the same sub-group, or destroys them. The analysis is applied to show that quartz has two piezoelectric moduli, whereas tourmaline has four.

A. J. C. W.

548.24 : 537 : 553.621 1728

Control of electrical twinning in quartz. WOOSTER, W. A., AND WOOSTER, N.; THOMAS, L. A., RYCROFT, J. L., AND FIELDING, E. A. *Nature, Lond.*, **157**, 405–6 (*March* 30, 1946).—Twinning in quartz specimens can be eliminated by applying a suitable mechanical stress while heating the specimen. The reclamation of much hitherto rejected quartz is a practical proposition, though all cuts cannot be so treated.

548.5 : 553.621 1729

Preparation of synthetic quartz. WOOSTER, N., AND WOOSTER, W. A. *Nature, Lond.*, **157**, 297 (*March* 9, 1946).

548.52 : 537.533.72 1730

A use of the electron microscope in chemical microscopy. GULBRANSEN, E. A., PHELPS, R. T., AND LANGER, A. *Industr. Engng Chem.* (*Analyt. Edit.*) **17**, 646–52 (*Oct.*, 1945).—Crystals for observation by electron microscopy are conveniently prepared by diffusion through the supporting plastic film. The film is floated on one reagent, and a drop of the other is placed on top of it. The variation of size and habit of Ag_2CrO_4 crystals with concentration of the solution is studied. Descriptions and photographs are given for crystals of about 28 substances. An attachment to the microscope for electron diffraction is useful for identifying crystals. A. J. C. W.

548.55 = 4 1731

Methods for preparing large crystals. KURYLENKO, C. *Rev. Opt.* (*Théor. Instrum.*) **23**, 1–19 (*Jan.–March*, 1944) *In French.*—Surveys the various methods for preparing large crystals by fusion and considers the difficulties due to convection currents, increase of viscosity on approach of solidification, contraction on passage from liquid to solid state. In the second part the various types of furnaces which have been used are described and a number of suggestions for modification put forward. A. H.

548.574 : 535.417 : 549.211 1732

Topography of the face of a diamond crystal. TOLANSKY, S., AND WILCOCK, W. L. *Nature, Lond.*, **157**, 583 (*May* 4, 1946).

548.7 1733

"Impregnation" of defect lattices in iron oxide scales. GOLDSCHMIDT, H. J. *Nature, Lond.*, **157**, 478–9 (*April* 13, 1946).—MgO is isomorphous with FeO, but has a smaller lattice perameter. It has been found, however, that forming a solid solution of MgO in FeO (by oxidizing Armco iron coated with magnesia) produces two phases with larger lattice parameters than FeO. The explanation is that the Mg^{++} ions, instead of replacing Fe^{++} ions, occupy vacant

lattice positions until all "holes" are filled. Some implications are briefly discussed.

548.7 : 536.631 *see Abstr.* 1617

548.73 1734

On the crystal structure of cadmium iodide. HÄGG, G., AND HERMANSSON, E. *Ark. Kemi Min. Geol.*, **17 B** (*No.* 3) *Paper* 10, 4 *pp.* (1943).—Slow crystallization gives crystals of the C 27 type. Rapid crystallization produces a random layer lattice. Intermediate rates give disordered structures whose powder photographs resemble those of the C6 structure. A. J. C. W.

548.73 1735

X-ray analysis of $FeSn_2$ and Fe_3Sn. NIAL, O. *Ark. Kemi Min. Geol.*, **17 B** (*No.* 3) *Paper* 11, 5 *pp.* (1943).—$FeSn_2$ is tetragonal, $a = 6{\cdot}520 \pm 3$ kX, $c = 5{\cdot}312 \pm 3$ kX, space group I4/mcm, 4 Fe in (a), 8 Sn in (h), $x = 0{\cdot}160 \pm 4$, isomorphous with $CoSn_2$. $MnSn_2$ has the same structure, with $a = 6{\cdot}646 \pm 3$ kX, $c = 5{\cdot}425 \pm 3$ kX, $x = 0{\cdot}159 \pm 3$. Fe_3Sn is hexagonal, $a = 5{\cdot}447 \pm 3$ kX, $c = 4{\cdot}352 \pm 3$ kX, space group C6/mmc, 2 Sn in (c), 6 Fe in (h), $x = 0{\cdot}840 \pm 3$, isomorphous with Ni_3Sn. A. J. C. W.

548.73 1736

The crystal structure of Daubréelite. LUNDQVIST, D. *Ark. Kemi. Min. Geol.*, **17 B** (*No.* 3) *Paper* 12, 4 *pp.* (1943).—Daubréelite occurs naturally in meteorites, approximate composition $FeCr_2S_4$. Synthetic material with this composition is cubic, $a = 9{\cdot}975$ kX, space group Fd3m, 8 Fe in (a), 16 Cr in (d), 32 S in (e), $x = -0{\cdot}128$. The radius of Cr^{++} appears to be about 0·9 kX. A. J. C. W.

548.73 1737

Pseudo-cubic compounds of alkaline earth oxides with tungsten and molybdenum oxides. ROOKSBY, H. P., AND STEWARD, E. G. *Nature, Lond.*, **157**, 548–9 (*April* 27, 1946).

548.73 1738

Correction of diffraction amplitudes for Lorentz and polarization factors. BUERGER, M. J., AND KLEIN, G. E. *J. Appl. Phys.*, **17**, 285–306 (*April*, 1946).—The corrections for Lorentz and polarization factors for trial and error crystal structure computations are discussed, following the general method recently presented [Abstr. 278 (1946)] for correcting X-ray diffraction data used in Fourier syntheses. The Lorentz correction has the form $(1/S)\csc\Upsilon$, where S is a scale constant characteristic of the reciprocal lattice level and whose form varies with the method of recording the data. The scale constant is eliminated by appropriate timing of the exposure. When many trial and error computations have to be made, there are advantages in using a scheme involving a correction factor $(\csc\Upsilon)^{\frac{1}{2}}$ instead of $\csc\Upsilon$. Tables are provided for these functions, for the polarization correction and for the combined Lorentz-polarization correction which is used in the special case of zero-level photographs. Tables are also provided for the functions $(h^2 + k^2)^{\frac{1}{2}}$ and $(h^2 + k^2 + hk)^{\frac{1}{2}}$, which are useful for computing the argument for the zero-level corrections of tetragonal and hexagonal crystals.

548.73 : 545.824 1739

Tabulated diffraction data for tetragonal isomorphs. FREVEL, L. K., RINN, H. W., AND ANDERSON, H. C. *Industr. Engng Chem.* (*Analyt. Edit.*) **18**, 83–93 (*Feb.*, 1946).

549.211 : 535.343.2–15 *see Abstr.* 1582

549.211 : 535.372 *see Abstr.* 1591

549.211 : 535.417 : 548.574 *see Abstr.* 1732

549.211 : 539.31 : 548.0 *see Abstr.* 1726

GEOPHYSICS 55

550.381 : 551.513 1740

A preliminary study of the relation between geomagnetism and the circulatory motions of the air in the atmosphere. WULF, O. R. *Terr. Magn. Atmos. Elect.*, **50**, 259–78 (*Dec.*, 1945).—Comparison is made of different forms of the daily traces of the geomagnetic elements with large-scale atmospheric pressure-patterns near the base of the stratosphere. Illustrations are given of a few daily examples, but the comparison is made by obtaining the averages of the magnetic elements and of certain characterizing features of the pressure-patterns for two groups of days equal in number for all of the days of each of 14 months. Comparison is also made of the daily values of magnetic disturbance (*K*-sums) with a measure of the change of pressure-pattern over the day for the days of the same interval. It is concluded that preliminary study does not afford reliable indication of a relation between geomagnetism and the circulatory motions of the air in the atmosphere.

551.14/.16 : 539.893 *see Abstr.* 1713

METEOROLOGY 551.5

551.501.9 1741

A buoy automatic weather station. MIDDLETON, W. E. K., AND COFFEY, L. E. *J. Met.*, **2**, 122–9 (*June*, 1945).—Describes the construction and performance of a floating buoy anchored on Lake Ontario during two navigational seasons. Observations of wind speed and air and water temperature are automatically transmitted by wireless every three hours to a station 11 miles distant. Improvements have been made in the apparatus from the experience of one season and the original calibration of the instruments has been checked. E. G. M.

551.508.21 1742

Static and pickup protection for pyrheliometer installations. IVES, R. L. *Bull. Amer. Met. Soc.*, **26**, 334–7 (*Oct.*, 1945).

551.508.5 1743

The development of a new wind measuring system. WOOD, L. E. *Bull. Amer. Met. Soc.*, **26**, 361–70 (*Nov.*, 1945).—This paper opens with a comparison of the two main types of anemometer, pressure operated and rotational. The efficiency of the pitot static, bridled, cupwheel and propellor types is discussed and the directional properties, speed response and mechanical stresses given in tabular form. These results have led to a design of propellor anemometer of light weight named the *Aerovane*. The basic

structure has been laid out so that its response can be transmitted by any of the methods in general use with rotation instruments. Wind tunnel tests and actual operation showed small errors at low speeds, quick response to gusty winds and direction changes. The complete anemometer and vane weighs 12 lb, the support tube, 12 ft in length, weighs 30 lb and requires no guying under normal conditions. Two types of indicator have been developed. E. G. M.

551.510.41 : 545.72 1744

A micro-analysis of the helium and neon contents of air. GLÜCKAUF, E. *Proc. Roy. Soc. A*, **185**, 98–119 (*Jan.* 10, 1946).—The theoretical conditions for the quantitative separation of gases by fractional adsorption are investigated. The micro-method and apparatus for the determination of the He and Ne contents of air by this method are described. The accuracy of the results is discussed especially with respect to the samples obtained from the stratosphere [Abstr. 1168 (1946)]. The most reliable absolute values are: He, $5{\cdot}239 \pm 0{\cdot}004$; Ne, $18{\cdot}21 \pm 0{\cdot}04$ parts per million. L. S. G.

551.510.53 : 551.524.7 1745

Meteorology of the lower stratosphere. DOBSON, G. M. B., BREWER, A. W., AND CWILONG, B. M. *Proc. Roy. Soc. A*, **185**, 144–75 (*Feb.* 12, 1946).—Before an estimate of the temperature in the stratosphere can be made it is necessary to know the relative amounts of H_2O vapour, O_3 and CO_2 in this region. Instruments are described which permit the accurate measurements of these amounts at all heights in the atmosphere which may be reached by multi-seater aircraft. Graphical results are given of a large number of measurements. The relative importance of various gases in the stratosphere is discussed. Estimates are made of the amounts of energy absorbed by H_2O vapour, O_3 and CO_2 in the stratosphere. The following changes are discussed: (1) annual variation of stratosphere temperature, (2) annual variation of height of the tropopause, (3) variation with latitude of the temperature in the stratosphere and height of the tropopause, (4) variation of temperature with height in the stratosphere, (5) variation of O_3 content and meteorological conditions. L. S. G.

551.510.535 : 551.594.6 *see Abstr.* 1752

551.511 : 551.57 *see Abstr.* 1749

551.513 : 550.381 *see Abstr.* 1740

551.513 : 551.554 1746

A generalization of the thermal wind equation to arbitrary horizontal flow. FORSYTHE, G. E. *Bull. Amer. Met. Soc.*, **26**, 371–75 (*Nov.*, 1945).—The formula for the change of wind with height is obtained under the assumptions: (*a*) the wind at each level is horizontal and is expressed in terms of the tangential and normal wind-components to the path; (*b*) there is a horizontal temperature-field; (*c*) the "vertical" variable is the geopotential. The author concludes from an analysis of the nature of the terms in this formula that its practical use is probably limited to the case of gradient winds. He shows how the shear of the wind is derivable and also obtains the direction and spacing of the virtual-temperature isotherms. G. C. McV.

551.515.8 : 551.577.2 *see Abstr.* 1750

551.524.7 : 551.510.53 *see Abstr.* 1745

551.526.6 1747

Fog forecasting and sea-surface temperature. EGGVIN, J., AND SPINNANGR, F. *Fiskeridirek. Skr.*, **7** (*No.* 9) 19 *pp.* (1944).—Twelve charts show monthly means of sea-surface temperature over the North Sea 1935–39. The data for the graphs are mainly thermograph records from instruments carried by coasting vessels. The temperature of the sea has in general been rising since 1920, but 1940–42 showed a decrease, followed by renewed increase. Using the charts for fog forecasting, account must be taken of both long-term variations and short-time effects, e.g. of wind. These effects are discussed. J. A. W.

551.554 : 551.513 *see Abstr.* 1746

551.556.3 : 621.315.1.056.4 = 397 1748

Wind pressure on power lines. SANDIN, S. *Tekn. Tidskr.*, **76**, 217–25 (*March* 2, 1946) *In Swedish.*—[Abstr. 1293 B (1946)].

551.57 : 551.511 1749

The different wet-bulb and equivalent temperatures. TRAEGDE, K. *Met. Ann.*, **1** (*No.* 16) 409–31 (1943).—The thermodynamics of atmospheric processes are discussed, including the case of hydrometeors, and it is shown that there is no wet-bulb or equivalent temperature which remains invariant for all atmospheric changes, but the variations of these temperatures must be taken into consideration in the analysis of air masses. At the boundary between adjacent air masses, the variations are usually rapid and may aid in drawing the fronts on synoptic charts. The diurnal variation of the wet-bulb temperature is shown. J. A. W.

551.577.2 : 551.515.8 1750

Synoptic studies on precipitation in Southern Norway. II. Front precipitation. SPINNANGR, F. *Met. Ann.*, **1** (*No.* 17) 433–68 (1943).—[See Abstr. 1176 (1946)]. The weather conditions, especially the precipitation, on a number of days are described, both for winter and summer cases, when a warm front passes over southern Norway from various directions and with different orientations. J. A. W.

551.594.22 : 621.316.9 = 397 1751

The over-voltage problem—some practical experiences. VRETHEM, Å. *Tekn. Tidskr.*, **73**, *E*1–13 (*Jan.* 2, 1943) *In Swedish.*—[Abstr. 1322 B (1946)].

551.594.6 : 551.510.535 1752

On the reflection of atmospherics from the ionosphere at night. CHIPLONKAR, M. W., AND HATTIANGADI, M. S. *Proc. Indian Acad. Sci. A*, **21**, 265–70 (*June*, 1945).—The wave-form of atmospherics at night was investigated using an aperiodic aerial (50 c/s–300 kc/s), an h.f. compensated RC coupled amplifier, a c.r.o. and a high-speed camera with a rotating drum. By a simple circuit arrangement using a multivibrator and a deflection modulator the brilliancy of the c.r. beam is quickly increased whenever there is a field change of sufficient magnitude (e.g. the leader stroke of a lightning discharge) and kept constant at a high value for a controllable time, generally about 0·01 sec. The results obtained from the records at Poona are compared with those obtained elsewhere. The duration of the primary pulse varied from 50–500 μsec and atmospherics originating as far away as 3 000 km have been recorded. The height of the ionosphere calculated

from the multiple reflections of the sky pulse varied from 75–105 km on different occasions. Occasionally as many as 42 reflections of the sky pulse from the ionosphere were recorded.

551.594.6 : 621.396.812 1755

Ionosphere storm effects in the *E*-layer. BENNINGTON, T. W. *Nature, Lond.*, **157**, 477–8 (*April* 13 1946).—[Abstr. 1449 B (1946)].

553.621 : 537 : 548.24 *see Abstr.* 1728
553.621 : 548.5 *see Abstr.* 1729
578.088.5 : 539.185.7 *see Abstr.* 1696
616–073.75 : 778.33 *see Abstr.* 1755
662.21 : 541.126 = 3 *see Abstr.* 1714
666.115 : 539.4.019 *see Abstr.* 1707
666.115 : 539.4.019.1 *see Abstr.* 1708, 1709
666.115 : 620.174.24 : 539.4.019.1 *see Abstr.* 1710
676 : 539.217.3 *see Abstr.* 1698–1700
676 : 539.217.5 *see Abstr.* 1701
681.4 : 535.81 = 4 *see Abstr.* 1607

PHOTOGRAPHY 77

77.012 : 541.124 1754

The charge effect in relation to the kinetics of photographic development. IV. The variation of emulsion speed with charge. The action of complex developers. JAMES, J. H. *J. Franklin Inst.*, **240**, 327–34 (*Oct.*, 1945).—[See Abstr. 185 (1946)]. The shape and position of the photographic characteristic curve obtained by incomplete development are determined by the nature of the function which relates the rate of density formation to the exposure, and, of the factors concerned, the charge effect is investigated now. Curves are obtained with three chemically similar developing agents viz. *sym*-dimethyl-*p*-phenylenediamine, methyl-*p*-aminophenol, and methyl-*p*-aminophenol monosulphonate. The photographic material used was a normal motion-picture positive film (C). In no case has a doubly charged agent been found which, in the early stages of development, gives an emulsion speed comparable to those obtained with the typical singly charged agents. In most cases sulphite is not adequate to remove the oxidation products of the *p*-phenylenediamine derivatives, and these products have an adverse effect upon development. Other ways of increasing the emulsion speed are discussed, including the influence of sulphite. The non-additive properties of the elon-hydroquinone combination and other similar combinations are attributed primarily to a change in the relative rates of reaction of the partners on passing beyond the induction period region. H. H. HO.

778.33 : 616–073.75 1755

An analysis of the physical factors controlling the diagnostic quality of Roentgen images. III. Contrast and the intensity distribution function of a Roentgen image. MORGAN, R. H. *Amer. J. Roentgenol. and Radium Ther.*, **55**, 67–89 (*Jan.*, 1946).—Previous papers [Abstr. 1190 (1946), 3033 (1945)] have dealt with the factors which control the quality of radiographs, i.e. the film or screen resolving power, and the resolution coefficient. The present paper deals with the contrast between the image and the surrounding field. The factors which control contrast are discussed mathematically and then methods of measuring these factors described. The ionoquantiter used for X-ray therapy measurements fails to respond spectrally in radiographic measurements. The film sensitometric method is more suitable, but presents problems of complexity. The recent development of the photo-electric intensitometer permits measurements to be made quickly, easily and quantitatively. To represent non-calcified tissues as fat, Masonite presswood has been used as a phantom material, and apatite, a calcium phosphate, to represent bone tissue. Extended graphical and numerical data of measurements so made are given. B. J. L.

778.34 : 539.163.2.08 *see Abstr.* 1686